A Survey by Operations Research Group

Mining in India

Mining in India

A SURVEY

Conducted under the Sponsorship of

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New Delhi

by

Operations Research Group
Baroda

PREFACE

Minerals constitute the fundamental primary resource of a country. The prospects for a country to bring to its people the benefits of modern technology and to improve its overall economy depend to a great extent on the development of its mineral resources. In India, in particular, suffering as it does from a trade deficit, increasing exports and curtailing imports by meeting more of its requirements from domestic production are of priority interest. In view of its sizeable mineral resources, accelerated exploitation of these resources must receive careful consideration.

In order to assist in the development of India's strategy for accelerating the exploitation of its mineral resources, the U.S. Agency for International Development commissioned the Operations Research Group to conduct a study. It is the purpose of this study to set forth basic data on the mining activity in the country and assist in the identification of activities which, when given proper assistance, could make the most impact on mineral development. We take pleasure in presenting this report at the completion of the study.

In the performance of this work, we interviewed a large number of officials of Government departments and agencies, mining operations and associations of mining operators. To all of them we are greatly indebted for their co-operation and the consideration shown to our interviewers. We specially thank Mr. T.N. Lakshminarayanan, Joint Secretary to the Government of India and Mr. T.L. Sankar, Deputy Secretary to the Government of India, of the Department of Mines and Metals, for their interest in the project and for providing an understanding of the Central Government's role in the development of the mining industry.

At a number of mines, our interviewers were provided accommodation and transport. These kindnesses are sincerely appreciated.

A study of this kind cannot be conducted without the assistance of expert consultants. Princess Bhuvanesh Kumari of Patiala served as our legal consultant. The chapters on legislation governing mining in India and in Canada are her able contributions. Mr. A. A. Ahmad Siddiqi, mining engineer, and Dr. B. B. Jambusaria, applied geologist, served on the team which performed the field work, and contributed their expert knowledge to the analysis of the information obtained and preparation of the report. We thank these consultants for their devoted performance on their assignments.

Mr. P.S. Thiagarajan and Dr. S.G. Narayanamurthy served as project directors on the study. Their principal associates were Messrs. N. Banerjee, A. Nag, V. Raghu and B.B. Samanta. Mr. S. Krishnamoorthy of our New Delhi office provided able administrative assistance. The cover was designed by Mr. Animish Sen Gupta of Shilpi Design Studio, Ahmedabad.

In closing, I wish to express our thanks to the U.S. Agency for International Development for sponsoring the study. We owe deep gratitude to Mr. David C. Woody, Mr. Josiah Royce and Mr. K.B. Gandhi for their advice and encouragement during the project.

November, 1971.

D.V.N. Sarma
Executive Director.

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PART I

CHAPTER I—MINERALS IN INDIA'S ECONOMY

1.1 India is fairly well endowed with mineral resources compared to most other countries. Her reserves of iron ore and coal are quite large and she possesses some of the best deposits of mica and kyanite. Development of the mineral industry was initiated during the Second Five Year Plan when emphasis was laid on the industrialisation of the country. As a result of the development programme mineral production which was hardly Rs. 1,000 million in 1955 rose to Rs. 1,772 million in 1961 and to Rs. 4,296 million in 1970. During the period 1966-70 the increase in the value of production has been at a compound rate of 10.8%. Mineral production in India in the years 1966 through 1970 is presented in Tables 1.1 and 1.2 in terms of value in the first and quantity in the second.

1.2 Coal, including lignite, is the largest contributor to the mineral production in the country. Its contribution during the years 1966 through 1970 has been between 55% and 62%. Petroleum and natural gas have accounted for 7% to 17% and the share of major minerals other than fuels has been fluctuating around 20%. Excluding the minor minerals the total mineral production has gone up from Rs. 2,917 million in 1966 to Rs. 4,296 million in 1970, i.e. at a compound rate of 10.8%. Production of major minerals other than fuels has increased from Rs. 663 million in 1966 to Rs. 932 million in 1970, i.e. at a compound rate of 10.7%.

Table 1.1 : Mineral Production in India 1966-70

(Value in million rupees)

Mineral	1966	1967	1968	1969	1970
All major minerals*	2,917	3,319	3,811	4,240	4,296
Coal including lignite	1,838	2,056	2,414	2,695	2,655
Petroleum & natural gas	416	550	571	697	710
Major minerals other than fuels	663	712	826	848	932
Metallic minerals	425	467	529	523	582
Non-metallic minerals	238	245	297	325	350
Iron ore	241	255	287	318	355
Chromite	5	8	13	13	14
Manganese ore	91	107	107	76	75
Bauxite	8	9	10	13	18
Kyanite	13	11	14	19	26
Lead concentrate	3	3	3	3	3
Zinc concentrate	4	5	8	8	10
Copper ore	27	31	35	38	37
Mica	24	20	21	19	19
Pyrites	—	—	3	8	6
Limestone	142	153	184	189	203
Dolomite	12	14	18	19	19
Other major minerals	93	96	123	125	147
Minor minerals	345	393	351	NA	NA

* Minor minerals and atomic minerals are excluded.

Source : IBM—Mineral Statistics of India, January 1971.

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Table 1.2 : Mineral Production in India by Quantity 1966-70

Mineral	1966	1967	1968	1969	1970	Value in 1970 (Million Rupees)	% Share of value of production in 1970
	In thousand tonnes						
Coal *	70	71	75	80	70	2,655	61.7
Petroleum	4,647	5,667	5,853	6,723	6,809	710	16.5
Iron ore	26,733	25,944	27,955	29,235	30,780	355	8.2
Manganese ore	1,710	1,616	1,610	1,463	1,651	75	1.7
Copper	484	470	484	510	518	37	0.9
Mica	23	18	18	18	16	19	0.5
Kyanite	64	50	64	84	119	26	0.6
Bauxite	750	804	958	1,063	1,359	18	0.4
Chromite	78	114	206	227	271	14	0.3
Pyrites	—	—	14	39	26	6	0.1
Lead	5	4	4	3	4	3	0.1
Zinc	9	10	13	14	10	16	0.2

* Includes lignite. Quantity in million tonnes.

Source : IBM—Mineral Statistics of India, January 1971.

Contribution to National Income

1.3 The contribution of the mineral sector to the national income in 1970 was Rs. 3,329 million. During the period 1966 to 1970 the contribution from this sector at current prices increased from Rs. 2,524 million to Rs. 3,329 million. The contribution to the national income from mining activity in fuels, coal, metallic minerals, non-metallic minerals, iron ore, mica and limestone in the period 1966-70 is presented in Table 1.3.

Table 1.3 : National Income from the Mining Sector

(In million rupees)

	1966	1967	1968	1969	1970	% Share (1970)
All minerals	2,524	2,885	2,987	3,285	3,329	100.0
Fuels	1,716	2,071	2,134	2,421	2,401	72.1
Coal	1,433	1,603	1,757	1,961	1,932	58.0
Metallic minerals	289	324	368	360	399	12.0
Iron ore	157	170	192	214	240	7.0
Non-metallic minerals	182	187	221	239	264	7.9
Mica	17	14	14	13	13	0.4
Limestone	103	110	132	106	145	4.3
All economic activities *	239,030	283,740	286,780	311,740	NA	

* Figures relate to financial years.

NA—Not available.

Source : IBM—Mineral Statistics of India, January 1971.

1.4 The exports of minerals from India accounted for 9.4% of the total export in 1969-70 and were valued at Rs. 1,328 million. Export of minerals, mostly metallic, has been steadily increasing (Table 1.4). Iron ore is the biggest contributor to the mineral exports and accounted for 6.7% of the all India exports or 71.2% of the mineral exports in 1969-70. Manganese ore and mica are the two other minerals which have sizeable export markets.

Export of Mineral

1.5 India relies heavily on imports, particularly for her petroleum, base metal and sulphur requirements. India imported Rs. 1,294 million worth of minerals and metals in 1969-70 and this accounted for 8.2% of the total import. Petroleum crude is the major import item in the minerals group, while iron and steel, copper, lead and zinc are the major metals and alloys that are imported. Table 1.5 gives the total imports of India in the years 1965-66 through 1969-70, and imports of selected minerals and metals. During these years the import of minerals has increased substantially, while the import of metals has been showing a decreasing trend.

Import of Minerals and Metals

Table 1.4 : Export of Minerals from India, 1965-66 to 1969-70

Name of Mineral	Value in Million Rupees					Per cent share in total exports in 1969-70
	1965-66	1966-67	1967-68	1968-69	1969-70	
Total Exports	12.687.6	11,646.9	11,928.0	13,563.4	14,086.4	100.0
All Minerals	1,120.1	1,073.4	1,089.0	1,253.7	1,328.6	9.4
Iron ore	663.0	702.0	747.8	884.0	946.2	6.7
Manganese ore	173.9	143.7	111.0	134.6	110.6	0.8
Chromite	5.3	12.8	13.2	19.6	27.2	0.2
Mica	58.8	62.7	67.6	64.8	75.9	0.5
Kyanite	12.3	13.5	16.7	17.8	24.0	0.2
Other minerals	206.8	138.7	132.3	132.9	144.7	1.0

Source : Monthly Statistics of Foreign Trade, Government of India.

1.6 Structure of the Industry

Coal (with 791 mines operating in 1970) has the largest number of working mines in the country, Mica (504), manganese (328) and iron ore (299) are the other minerals having a large number of operating mines. Ownership of all types

Predominantly Private Sector

—proprietorship, partnership, joint stock company (both public limited and private limited) are prevalent. Mines in the private sector far outnumber those in the public sector. Most of the public sector mines are in different stages of development e.g. the Bailadila, Kiriburu, Malangtoli, Kudremukh, Donimalai iron ore mines, the Zawar lead-zinc mine, the Khetri copper mine and the Amjhore pyrite mine. It is expected that these public sector mines when fully developed will have a major share in the country's mineral production. Tables 1.6, 1.7, 1.8 and 1.9 provide details of the mines operated during 1970, the nature of ownership, market (captive or non-captive), number of principal mines and the production in the two sectors, private and public.

Table 1.5 : Imports of Minerals & Metals to India, 1965-66 to 1969-70

Name of Minerals/ Metals	Value in Million Rupees					Per cent share in total export in 1969-70
	1965-66	1966-67	1967-68	1968-69	1969-70	
Total Imports	21,956.1	20,323.5	19,742.71	8,616.2	15,674.9	100.0
All Minerals	833.9	737.5	1,159.9	946.7	1,294.5	8.2
Asbestos	44.6	49.7	53.7	40.8	64.1	0.4
Industrial Diamonds	2.9	8.0	12.0	7.1	6.0	—
Petroleum Crude	549.3	379.9	597.2	543.1	963.2	6.1
Phosphate	87.6	131.6	94.0	124.5	82.2	0.5
Sulphur ..	107.2	126.7	367.4	177.2	107.0	0.7
Zinc concentrate	—	12.4	0.3	16.5	27.3	0.2
Other Minerals	42.3	29.2	35.3	37.5	44.7	0.3
All Metals	2,620.8	1,830.1	1,948.9	1,751.4	1,541.0	9.8
Iron & Steel	1,539.6	972.7	1,061.6	861.5	811.4	5.2
Copper & Copper Alloys	524.8	390.7	354.6	391.6	473.8	3.0
Nickel	29.3	14.4	35.0	57.4	28.1	0.2
Aluminium	99.0	152.0	176.6	45.1	15.1	0.1
Lead	90.2	104.3	62.1	63.9	64.4	0.4
Zinc	202.2	109.6	142.9	198.9	82.5	0.5
Tin	112.9	69.3	95.2	115.5	62.9	0.4
Other Metals	22.8	17.1	20.9	17.5	2.8	—

Source : Monthly Statistics of Foreign Trade, Government of India.

Table 1.6 : Mines in India Classification by Ownership and Market for Minerals under Study, 1970

Mineral	India			Public Sector			Private Sector		
	Total	Captive	Non-Captive	Total	Captive	Non-Captive	Total	Captive	Non-Captive
Bauxite	62	15	47	3	1	2	59	14	45
Chromite	12	—	12	5	—	5	7	—	7
Copper@	7	5	2	2	2	—	5	3	2
Iron Ore	299	14	285	29	9	20	270	5	265
Lead-zinc	1	1	—	1	1	—	—	—	—
Manganese	328	10	318	18	2	16	310	8	302
Kyanite	14	—	14	1	—	1	13	—	13
Mica	504	—	504	4	—	4	500	—	500
Pyrites	1	—	1	1	—	1	—	—	—

@ Includes Khetri and Kolihan which are under development.
Captive—Producer consumes its own output.
Non-Captive—The output is available for sale.
Source : IBM - Mineral Statistics of India, January 1971.

Table 1.7 : Principal Mines in India—Classification by Characteristics for Minerals under Study

Mineral	Area States	Princi-pal area States	Enterprise		Establishment		Market	
			Pub. Sector	Pvt. Sector	Pub. Sector	Pvt. Sector	Cap-tive	Non-Captive
Bauxite	7	6	1	22	1	25	7	19
Chromite	3	3	2	4	3	5	1	7
Copper	3	1	—	1	—	3	3	—
Iron ore	7	4	8	18	15	22	14	23
Lead-zinc	1	1	1	—	1	—	1	—
Maganese ore	7	5	2	23	13	31	4	40
Kyanite	4	1	1	2	1	2	—	3
Mica	5	3	1	62	3	135	—	138
Pyrites	1	1	1	—	1	—	—	1

1. Area : Different States of mineral occurrence.
2. Principal areas—Principal States of mineral occurrence.
3. Enterprise—Number of lessees who own the principal mines.
4. Establishment—Numbe of principal mines.
5. Market—Non-captive or Captive—on usage.

Source : IBM—Mineral Statistics of India, January 1971.

Table 1.8 : Production by Quantity and Value of Captive and Non-captive Mines for Minerals under Study

Qty. in thousand tonnes
Value in thousand rupees

Mineral	Total		Captive		Non-captive	
	Qty.	Value	Qty.	Value	Qty.	Value
Bauxite	1,360	17,593	864	10,161	496	7,432
Chromite	271	14,418	—	—	271	14,418
Copper	518	37,477	518	37,477	—	—
Iron Ore	30,780	355,454	10,278	127,221	20,502	228,233
Kyanite	119	25,637	—	—	119	25,637
Lead	4	2,982	4	2,982	—	—
Manganese	1,651	74,906	145	10,362	1,506	64,544
Mica	16	18,896	—	—	16	18,896
Pyrites	26	5,615	—	—	26	5,615
Zinc	16	9,630	16	9,630	—	—

Source : IBM—Mineral Statistics of India, January 1971.

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Table 1.9 : Production of Minerals Under Study-Classified by Ownership and Market

Qty. in thousand tonnes
Value in thousand rupees

Minerals	Public Sector						Private Sector					
	Total		Captive		Non-captive		Total		Captive		Non-captive	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
Bauxite	27	783	5	139	22	644	1,333	16,810	859	10,022	474	6,788
Chromite	90	5,897	—	—	90	5,897	181	8,521	—	—	181	8,521
Copper	12	—	12	—	—	—	506	37	506	37	—	—
Iron ore	12,497	152,985	6,757	72,305	5,739	80,680	18,284	202,469	3,521	54,916	14,763	147,553
Kyanite	16	3,787	—	—	16	3,787	103	21,850	—	—	103	21,850
Lead	4	2,982	4	2,982	—	—	—	—	—	—	—	—
Manganese	400	27,123	32	732	368	26,391	1,252	47,783	113	9,630	1,139	38,153
Mica	44*	66	—	—	44*	66	16	18,830	—	—	16	18,830
Pyrites	26	5,615	—	—	26	5,615	—	—	—	—	—	—
Zinc	16	9,630	16	9,630	—	—	—	—	—	—	—	—

* Quantity in tonnes

Note : Bolani Ore Ltd. (Producing Iron ore and Manganese ore) & Manganese Ore (India) Ltd. have been included under public sector even though they are joint private sector and public sector ventures with 51% public sector investments.

Source : IBM—Mineral Statistics of India, January 1971.

CHAPTER II—SCOPE OF STUDY AND METHODOLOGY

1. Scope of Study

1.1 There is a good prospect that rapid development in the exploitation of the country's mineral resources could significantly accelerate the pace of India's economic development. In particular, the trade deficit can be reduced by increasing exports and by substituting domestic production for imports of minerals and metals. In order to assist in the development of a strategy for accelerating the exploitation of the mineral resources, the U.S. Agency for International Development commissioned the Operations Research Group to conduct a study. It is the purpose of this study to set forth basic data on the mining activity in the Country and assist in the identification of activities, which, when given proper assistance, could make the most impact on mineral development.

1.2 As the legislation governing the mining activity and its economics, and the manner of administration of the legislation, would have important influence on the formulation and prospects for success of the assistance strategy, these factors were to be studied and analysed. Information on the status of the industry was to be obtained by a survey of about one hundred mining units, and the information analysed with a view to identification of the inputs needed to accelerate mineral development. The extent to which such inputs are available from existing facilities and institutions, and what special measures are needed to meet the deficiencies were to be outlined.

1.3 As Australia and Canada have made rapid strides in the beneficial exploitation of their mineral resources in recent years, a comparative study of the legislation in these countries bearing on the functioning and economics of the mining industry with that of India was to be made with a view to identifying features that could account for the contrasting rates of development.

1.4 In view of the short-term available for the study, the survey was to concentrate on ten minerals—iron ore, chromite, manganese ore, bauxite, kyanite, lead, zinc, copper, mica and pyrites—in the States of Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Mysore, Orissa and Rajasthan and the Union Territory of Goa.

2. Methodology

2.1 As the survey of mining units was to encompass the larger ones, the Directory of Principal Mines, published by the Indian Bureau of Mines, was consulted. An initial sample of 121 mines in the selected minerals distributed over the States of interest was collected from the Directory. It was decided that where one owner was operating a number of mines in one area, only a few of them will be covered. The selection of mines was to be done in the field after consultation at the owner's head office or field office. At the same time the survey teams were to contact a few smaller mineowners, not listed in the Directory, they encounter during their travel, in order to give them some representation.

2.2 An experienced mining engineer and a geologist were recruited on contract and were available for the entire study. The services of another mining engineer was available in the early part of the study, at the time of obtaining background information and constructing the questionnaire for the mines. Two research analysts on ORG's staff had visited a large number of mica mines in the country in the course of a study on export prospects and problems of the industry (financed by the USAID for the Ministry of Foreign Trade) in the latter half of 1970. They participated in this study. Two more ORG analysts, a mechanical engineer and an economist with experience in programme evaluation work, completed the field force, consisting of three teams of two members each.

2.3 Letters were sent to mineowners and mines informing them of the purpose of the survey and outlining the data needed. Teams started in Bihar, Orissa and Gujarat, and after two weeks a review meeting was held, attended by all study personnel. The main findings at the review were that the field personnel had had to give an assurance that data on individual units would be kept confidential, and that even then many mineowners would refuse to give financial data, including capital employed, cost of operation etc. The above conditions proved true in the rest of the survey ; in some cases there is reason to suspect production figures also. Data from a total of 122 mines were collected.

2.4 A legal consultant was employed to survey the legisation and outline the salient features of legislation bearing directly on mining activity in the major minerals other than fuels, and of general legislation bearing on the organisation of mining activities and their economics. The consultant also made a comparative study of important features of legislation governing mining activities in Canada with those in India. Adequate material on legislation in Australia was not available in time to be included in this study.

2.5 Officials in administrative departments at the Centre and in the States were interviewed with the purpose of delineating their respective spheres of responsibility and action. Associations of the mining industry, officials of financing institutions and scientists at research institutions were contacted to secure information on various aspects relating to the operation of the mining activity and the availability of inputs needed for its efficient functioning.

3. Organisation of Report

3.1 Part II presents, by mineral, the mining activity in India and relates it to world activity, domestic resources and demand and India's foreign trade. The characteristics of the industry and its problems and prospects are discussed.

Part III presents the salient features of direct legislation governing the mining of major minerals (other than fuels) and general legislation bearing on the organisation, conduct and economics of mining. The administrative agencies vested with responsibility in administering the direct legislation are identified and their work is described.

Part IV presents principal features of direct and general legislation governing mining in Canada and compared them with related provisions in Indian legislation.

Part V analyses the characteristics of the various functional components of mining in India, and the inputs from the environment—legislation and its administration, infra-structure, financing and research.

Part VI presents a statewise picture of mining activity in the minerals covered. In the case of minerals in which production comes essentially from one State, for example chromite from Orissa and pyrites from Bihar, activities in these minerals are referred to only briefly under the State, as the presentation by minerals is more exhaustive.

3.2 It would be appropriate here to define some of the terms used in the report. "Value of production" is the price realised by the industry at the mine, after deducting from the actual price the cost of transportation to the point of delivery (including loading and unloading, if applicable), royalty and taxes on the sale. "Value of export" is the price realised f.o.b. or f.o.b.t, as the case may be, at the ports of despatch.

Mining cost includes expenses on labour, supervisory staff, explosives and other consumables directly related to production. F.o.r. cost includes mining cost, fixed charge on investment and other indirect costs incurred till the ore is loaded on rail (including royalty).

F.o.b.t. cost is composed of f.o.r. cost, freight charges, port handling charges, export duties etc.

Open cast mines have been classified as "non-mechanised", "semi-mechanised" and "mechanised". In the non-mechanised mine all productive activity is manual, including drilling for blasting, if used Pumps for dewatering might be driven by engines (including electrical motors). A semi-mechanised mine is one in which pneumatic drills are used for making holes for blasting. Trucks or dumpers might be used, loaded and unloaded (in case of trucks) manually. A mechanised mine is one in which loaders, bulldozers or other earthmoving, excavating or material handling equipment are used.

In underground mines, the "semi-mechanised" category is omitted. A mine is said to be mechanised if pneumatic drills are used for drilling and engine drive is used for hauling material to the surface.

In captive mines the entire production is earmarked for one processing unit. In most cases the processing unit owns and operates the captive mine. The output of a non-captive mine is available for sale.

Of the nine political units covered in the survey, eight are States and one, Goa, is an Union Territory. For ease of presentation, Goa is also referred to as a State.

CHAPTER III—SUMMARY OF FINDINGS

1. Review by Mineral

1.1 Iron Ore

Decline in Production in Three Major States

There has been a declining trend in the iron ore production of three major producing States, viz., Orissa, Bihar and Mysore. While lack of an adequate outlet is the main reason in the first two States for decrease in their production, lack of finance is a major problem with the mineowners in Mysore who have now to deal with reefs instead of float ore.

Beneficiation and Agglomeration Necessary on Economic Grounds

In spite of the vastness of resources rational utilisation of iron ore is necessary on economic grounds. Presently, beneficiation of iron ore is confined to a few mechanised mines where ore produced is of low grade. Sintering and pelletising are the two methods of agglomeration used in this country. The major advantage of using sinters in the blast furnace are smooth furnace operation, higher production and reduction in coke rate. Use of fluxed sinters reduces the slag volume. Preparation of sinters is economical as the raw materials used for it are either rejects or waste materials. Experience in India shows that production in steel plants using sinter has gone up by 64%, and at the same time there has been a reduction in the consumption of coke by 33%. Establishment of pelletisation plants have dual effects. On the one hand, it will provide the mineowners an outlet to market the fine ores and on the other hand it will help the country to earn more foreign exchange as the unit realisation on pellets is more than on lumps and fines.

Price Realisation Very Low

Price realisation (both f.o.r. and f.o.b.t.) in the iron ore industry is very low as compared to many other minerals. The reason for such marginal realisation is that while the selling price has not changed much over the past few years, there has been considerable increase in the wage rate, price of machinery and equipments, interest rate, transportation and freight charges. While transportation cost accounts for 30 to 50% of f.o.r./f.o.b.t. cost, export duty which has been imposed in the wake of devaluation constitutes 15% of the f.o.b.t. price. There has also been withdrawl of the tax benefit of 10% on the export of fines.

Marketing and Transportation Problems

The major problems of marketing faced by this industry have been the lack of good transport system, adequate number of wagons and proper port facilities. Lack of an adequate outlet for iron ore is a problem particularly in the eastern sector. Besides there has been lack of coordination between transport and shipping. A solution to the problem posed by high road transport costs can be obtained either by improving the existing bad approach roads or extending the railway sidings where there is a large concentration of mines and the volume of ore transported is quite high. In this connection extension of the railway sidings from Banspani to Joruri (Orissa) is an urgent need in the eastern sector.

The major drawbacks of the present port facilities are lack of sufficient provision to handle carriers above 30,000 tonnes and to complete loading in time.

Future Estimates

India, with her presently known iron ore resources, can meet both internal demand as well as exports for more than two centuries even at the rate of 125 million tonnes (MT) a year. The Fourth Five Year Plan envisages a target of raising the production of iron ore so as to reach 51.4 MT. This will help the country to export 31 MT of ore by 1973-74. Both public as well as private sectors have to play significant roles to achieve this ambitious plan. This calls for completion of public sector projects in time and large financial investment in the private sector. An adequate supply of wagons and completion of the expansion plans of the ports are necessary to meet this challenge. Latest available information indicates that port expansion targets are likely to be delayed by about two years.

1.2 Chromite

Uncertainty of Occurrences

Chromite generally occurs as veins, lenses and bands within ultrabasic rocks. These lenses and veins occur in an extremely faulted zone and due to highly disturbed nature of the ground mining becomes difficult and costly.

Conservation

Because of the scarcity of this ore, its conservation has become a vital task. Use of this scarce ore has not been done in a rational way. Even ore of metallurgical grade is being used in refractories. It has been estimated that a limited quantity of the country's chrome ore reserve is lumpy and high grade and suitable for metallurgical industries. There has been a substantial quantity of friable ore of high grade which is not suitable for metallurgical purpose simply because of its powdery nature. Such ores can be agglomerated without initial upgrading. It has been estimated that the capital investment required for a chromite pelletisation plant with 100,000 tonnes per year capacity is about Rs. 30 million. There are also possibilities of upgrading the ferruginous ore with the help of mineral dressing techniques such as size classification, gravity separation, floatation and pyro and hydro-metallurgical methods.

Lack of Good Approach Road

One of the major problems of the industry has been lack of a good road from the mine head to the nearest district road/highway. In the major chromite belt (Sukinda Valley) of Orissa attempts are being made to construct a pucca road (40 kms) between Tomka and Goda. This road will conect the mines with the expressway near Tomka on one side and a district road on the other. Since this project will involve substantial investment, financial assistance is needed for its early completion.

Detailed Exploration

Even if the present production level is maintained, the surplus of chromite over internal demand will be 171 thousand tonnes in 1973-74 and 128 thousand tonnes in 1978-79. Recent trend in world chromite export puts India in a sound position. In order to make the most of this advantage detailed exploration

needs to be carried out to locate more chromite bearing areas, and feasibility of agglomerating fines and friable ores, examined with vigour.

1.3 Manganese Ore

Un-organised Nature of the Majority of the Units

It may be generally said (with the exception of a few major mines including the captive ones) that the manganese ore industry in India is not working on an organised basis. Working of the majority of the mines are characterised by lack of systematic exploration, planned working (in relation to layout, disposal of overburden etc.) and programmes for future development.

Need for Extensive Exploration

Annual production of manganese ore of all grades in India is expected to be about 2.6 MT by 1973-74. Against this, proved reserves at present are only of the order of 12 MT. Total measured and indicated reserves of all grades are about 50 MT. This points to the need for immediate and extensive proving operations.

Declining Prices

Marketing of manganese ore in India is faced with the problem of almost constant domestic prices (selling prices of high and medium grade ores of some of the mineowners show a downward trend) and declining export prices of all grades of ores since 1966.

The most immediate problem facing the manganese ore industry in India is associated with transportation. Transportation poses a problem at each phase of ore movement. Between the mine head and the railway station, the problem in the majority of the cases is of bad approach roads and/or long distance of the railway stations from the mine heads and the resultant high cost of transportation. At the loading station there exists the chronic problem of non-availability of wagons resulting in accumulation of stocks at the railway sidings. Besides non-availability of wagons the most important problem involved in railway transportation is the high incidence of the freight rate.

1.4 Bauxite

Privare Sector Dominant

Bauxite mining has been predominantly in the private sector. There are several large mines, mechanised to a greater or lesser extent, in Bihar, Madhya Pradesh and Maharashtra. They either are captive mines or have one of the aluminium smelters as a leading customer. Smaller mines predominate in Gujarat. They have been export oriented, but their production and exports have fluctuated widely in the past decade.

Large Domestic Market

As capacity in the Indian aluminium smelting industry has been growing rapidly, domestic production of bauxite also has kept pace. In 1969 the production was 1.06 MT and in 1970, 1.43 MT. Exports touched a peak of 249 thousand tonnes in 1962, representing 42% of the production that year. Export in 1970 was 68 thousand tonnes, only 5% of the production.

Conservation Necessary

The demand for bauxite from domestic smelters in 1980-81 is estimated as 2.6 MT. Reserves of bauxite in India are estimated as 65 MT, much of it low grade. Therefore, even in order to sustain the domestic smelting industry, there is need to explore vigorously for the ore. The known reserves can also be made to go a longer way by beneficiating run-of-mine ore or by developing processes for utilising the inferior grade ore.

Except from Gujarat, where private mining operators have complained of the State stifling their efforts to expand, and of inadequate facilities for export, few special problems have been reported by the industry.

Considering the domestic reserves and demand, a long range policy with respect to export of bauxite should be formulated.

1.5 Kyanite

The bulk of the demand for kyanite, domestic as well as overseas, is for the kyanite containing 60% and above alumina (Al_2O_3), called 'commercial grade'. Kyanite of lesser alumina content finds negligible uses at present. However, the reserves of kyanite of +60% alumina are very limited in the country. The Indian Copper Corporation Ltd., which has the biggest deposit of commercial grade kyanite in India, has reported its reserves to be only of the order of 229,000 tonnes. This estimate is considered to be rather conservative. The Geological Survey of India estimates the reserves at ICC's Lapso kyanite mines at 0.7 MT. At the present rate of production, the known reserves amount to only five or six years' production. All efforts should therefore be made to augment the reserves by intensive geological investigations.

Limited Reserves of High Grade Kyanite

The total reserves of kyanite are estimated to be 10.37 MT in the country, but the commercial grade forms only a small percentage of it. To improve the alumina content of the poor/low grade ore, economical and effective beneficiation needs to be undertaken.

Need for Beneficiation

1.6 Lead-Zinc

There are only two mines in the country mining lead and zinc and these are at different stages of development. At present only a small percentage of the country's requirement of lead and zinc is met my indigenous production (10% for zinc and 4% for lead). The short-fall in availability by the end of the Fourth Plan would be about 50% and 90% for zinc and lead respectively.

Production Small

Hindustan Zinc Limited, the only unit mining lead and zinc in the country, is expected to not only utilise the existing capacity of 18,000 tonnes of the Debari Zinc Smelter but also double the capacity by the end of the Fourth Plan. The mines are expected to be developed to sustain a production of 2500 tonnes per day of run-of-mine ore. Modernisation of the lead smelter at Tundoo, which is obsolete, would permit recovery of useful traces of valuable metal in the lead

Hindustan Zinc Ltd.

concentrate other than silver. The smelter, at present working very much below the rated capacity (33%), is expected to be worked to capacity with imported concentrates after modernisation.

It is necessary to accelarate the development of the mine in areas where substantial ore deposits have been proved, namely Zawar, Ambamata and Agnigundala and also encourage more detailed and more intensive exploration in these areas. It is also essential that studies be conducted for the possible substitutes of these metals by indigenously available material in various applications.

Need for Rapid Development

It is encouraging to note that with a view to accelarate the exploration and exploitation of the Pb-Zn deposits and to study the feasibility of establishing new smelters of the Imperial smelter type the Central Government has proposed to take the assistance of competent consulting firms of international repute. Action has already been initiated to invite offers for technical assistance.

Prospects of Technical Assistance

1.7 Copper

The copper mining industry in India is seriously underdeveloped. Present production, from the one and only productive mine (at Mosaboni in Bihar), meets only 10% of the country's demand for copper. India relies heavily on imports.

Production Fraction of Demand

Production of copper has been virtually stagnant since 1960. At present several projects are being implemented to increase production capacity. Khetri, Rakha and Ambamata-Dariba, when fully developed, will have a total installed capacity of 53,500 tonnes of electrolytic copper per annum. The existing capacity at Mosaboni is also being increased.

Projects for Capacity Expansion

Even the proposed increases in capacity will not substantially affect the large supply-demand gap. Long gestation periods and large capital investments are involved in the development of underground mines. As the projects above strive towards production, the demand will keep increasing steadily.

Proposed Capacity Inadequate

The Malanjkand prophyry deposit holds high promise as a source for copper. An opencast mine would have a comparatively shorter gestation period at a lower capital cost. Development to a capacity of 25,000 tonnes per annum appears feasible.

Malanjkand

1.8 Mica

The most pertinent problem facing the mica industry in India, at present, is of increasing cost of mining against stationary floor prices for exports. In addition to the increase in prices of major mining inputs, there had been considerable increases in the royalty rates on crude mica and mica scrap and waste during the period 1966-70. Against the above increases in costs, the floor

Increasing Cost Versus Stationary Floor Prices

prices for mica blocks, films, splittings and scrap and waste have not been revised ever since they were fixed in 1964. This has affected the profitability of the mining operation adversely and has been clearly reflected in the decline in the number of working mines and in production.

Declining Export of Splittings

Export of splittings from India has suffered a serious setback in the world market because of competition from the reconstituted mica paper industry. The only way to avert further decline in the export of splittings and to restore it to at the original level is to make splittings available to the foreign buyers at lower prices. One way to achieve this, without affecting the f.a.s. prices, will be to abolish the export duty altogether. But this may be counted as only as a short-term relief to the industry.

Need for Developing Fabrication Industry

The long term prospects of the industry lie in the development of fabrication activities. Export prices are directly negotiated with the foreign buyers on the basis of the technical specifications for the different parts to be fabricated. There is a good deal of flexibility in price and it is expected that with the development of the fabrication industry the mineowners would be in a position to obtain better prices, provided they are able to meet the exact needs of the buyers, including assurance on delivery. This is likely to revive the mining activity.

There is a steady world demand for fabricated mica parts and that India has good prospects in export of fabricated mica is evidenced by increasing exports during the period 1965-66 to 1969-70.

1.9 Pyrites (Sulphur)

New Mining Activity

Mining of pyrite is a comparatively new mining activity in India and production of ore from the one and only operating mine—a public sector undertaking, started in 1968. The present level of production barely meets 2.6% of the demand for sulphur.

Need for Intensified Exploitation

Though there are substantial proven reserves of sulphur in India, the indigenous supply gap continues to increase, emphasising the urgent need for intensified exploitation of the country's pyrite resources.

High Costs of Pyrite Mining

Comparatively high mining costs are associated with pyrite mining in India, which are largely attributable to inadequacies of present mining techniques and poor selection of mine equipment. Rationalised mining methods suitable to the geology of the pyrite deposits and choice of equipments on relative economic merits should cut down operating costs.

Need for Beneficiation

At present, apart from hand-picking of waste rock no beneficiation of the ore is done. Increased levels of production have resulted in loss of grade largely due to ineffectiveness of manual separation of waste rock in bulk production. High grades of production can only be re-established by beneficiating the ore. The relative merits of the various methods of beneficiation need to be evaluated.

2, Legislation and Administration

2.1 The Indian Constitution gives the Parliament the right to legislate on mining to the extent it considers expedient in the public interest, and residuary right is given to State legislatures.

Centre Dominant Authority

The Mines and Minerals (Regulation and Development) Act, 1957 is the principal enactment of the Parliament specifying the Central and State Governments' authority and responsibility in the grant of mineral concessions and the regulation and development of mining activities. The Central Government is given wide powers to regulate the mining of major minerals.

MCDR & MCR

The Mineral Conservation and Development Rules, 1958 and the Mineral Concession Rules, 1960, were made by the Central Government under the authority given by the MMRD Act. The MCDR vest the Controller, Indian Bureau of Mines, with the authority to monitor mining activity in the major minerals, other than fuels, and requires mine operators to provide information to the Controller in prescribed manner. The MCR lays down detailed rules for the grant of mineral concessions and specifies the conditions and rights to be attached to the concessions.

Labour Welfare and Safety

The Mines Act, 1952 is the principal enactment of Parliament regulating the working of mines from the point of view of welfare and safety of persons working in mines. It amends and consolidates earlier legislation on these matters. It provides for the appointment of certain officers for the purpose of monitoring working conditions in mines. It provides for the constitution of Mining Boards which the Government can consult on the implementation of the purpose of the Act.

The Mines Rules, 1955 were framed by the Central Government in exercise of its powers granted by the Mines Act, to regulate working conditions in mines from the point of view of welfare of the employees. The Metalliferuos Mines Regulations, 1961, provide in detail for the various specificiations to be followed in the working of mines and the various precautions to be observed for assuring safety of the employees.

Department of Mines, IBM and GSI

2.2 The Department of Mines, under the Ministry of Steel and Mines, is the Department of the Central Government through which the Government's authority and responsibility, as conferred by the MMRD Act, are discharged. The Department possesses powers of revision of orders passed by State Governments in respect of mineral concessions. The Department has administrative control of a number of mineral exploitation agencies that have been set up in the public sector. It exercises administrative control over the Indian Bureau of Mines, which has the responsibility for regulating conservation and development of minerals, and the Geological Survey of India, which has the responsibility for generating information on the mineral resources of the country.

DGMS

The Mines Act and the Rules made thereunder are implemented by the Ministry of Labour through the Directorate General of Mines Safety, with its head office in Dhanbad, Bihar.

State Agencies

The State Government exercises its authority and responsibility through a Department, usually termed the Department of Mining and Geology. The State prescribes the procedures for applications for mineral concessions and the processing of these applications. The Department assesses royalty and other dues payable to the State by mines and monitors their payment. The Department serves the cause of development of the State's mineral resources by carrying out geological investigations and publicising the State's mineral wealth. Most States have set up corporations in the public sector for exploitation of selected reserves.

2.3 Mining receives little special consideration in general legislation. Company Law, excise duties, sales tax levies, customs duties etc. take no special notice of the mining industry. The income tax regulations make certain special provisions for mining. In general, it cannot be said that any significant incentives are offered to the mining industry.

3. Comparison with Canada

Provinces More Autonomous

3.1 Direct legislation on mining in Canada is vastly different in character, and in the regulating procedures from that in India. Federal legislation governs mining only in certain parts of Canada in which the lands vest in the Federal Government. It does not apply to the Provinces of Canada, which have their own mining, safety, labour and tax laws. The features of only the Federal legislation are presented and compared with those of Indian legislation.

In Canada a mining lease can be obtained only after a certain amount of prospecting has been performed. Royalty is levied uniformly on all minerals (other than certain specified minerals of lesser importance), and is based on the value of the output of the mine. The levy increases in slabs up to a maximum of 12% on production of value above $ 35 million annually.

Many Special Incentives

3.2 A depletion allowance of 33 1/3% of the profits from a mine is allowed. Almost all equipment which find application in mining are exempt from sales tax, and equipment allowed to be imported is exempt from customs duty.

Depreciation allowances are generous. Shareholders in mining companies get a deduction based on their income from these companies. Special exemptions are given for investment in prospecting.

4. Analysis by Activity and Inputs

4.1 **Legislation and Administration.** There are many provisions in direct legislation, and procedures in administration thereof, which are reported to hamper the economics and prospects for rapid development of the mining industry.

Suggestions for improvement of existing regulations and practices have come from the industry, the Mineral Advisory Board meetings and Commitees set up by the Government for examining various aspects (of regulations and practices). Some of these have been accepted by the Government, and many more appear to be worthy of careful consideration. The pace at which the former are being implemented, and the latter examined, appears unsatisfactory.

Legislation and Administration

4.2 Exploration

General exploration of the country's mineral resources, primarily the responsibility of the Geological Survey of India, is being conducted with vigour. The conduct of intensive exploration, and the facilities therefor, appear inadequate. Repeated transfer of Government's activity in this respect between the GSI and the IBM, probably has contributed to its ineffectiveness. Work done by prospecting licences is also minimal. Large public sector and private sector ventures make some contribution, but determined and imaginative action on the part of Government is necessary to increase the pace of intensive exploration and proving of the country's resources.

Intensive Exploration

4.3 Mining

Both underground and opencast mining methods are adopted in the country. All iron ore, bauxite, kyanite and chromite (excepting one mine in Mysore) mines are opencast. Copper, lead-zinc and pyrite mines are underground. Most of the manganese mines are opencast and those of mica are underground.

Mining Methods

Mechanisation is restricted to a few large opencast and underground mines. Large capital investment needed, lack of technical knowledge, non-availability of proper equipment, spares and stores, restrictions on import, long waiting time for indigenous supplies, non-availability of elecricity and small lease areas have been the major reasons for most of the mines being either non-mechanised or semi-mechanised.

Low Degree of Mechanisation

At present processing of the mined ore is done on a very limited scale. Washing is the only method of beneficiation adopted by most of the operators. There are only two units in the country producing pellets from iron ore fines and six public sector units have sintering plants.

Beneficiation Not Prevalent

With the exception of a few major units (including captive mines), it may be generally said that the working of the majority of the mines are characterised by lack of systematic exploration, planned working (in relation to layout, disposal of overburden, etc.) and programmes for future development.

Mining Not Scientific

4.4 Transportation

In most parts of the country, minerals move in trucks over poor roads up to the point of transfer to rail or river transport. Trucking costs over leads of a

Road Transport

few miles might equal the mining cost of minerals such as iron ore, bauxite and manganese ore. There is every indication that trucking charges (or costs) will be reduced if access roads to mines are improved in quality.

Rail Transport

The railway is the cheapest means of transporting most minerals over long distances. Railway freight has been increasing steadily during the past few years. The 1971 budget has increased freight by about 6%. The question of giving concessional rates to mineral transport is a large one, requiring careful consideration from the point of view of the national economy. However, there is room for improvement in the quality of the service, in making it responsive to the needs of the industry.

Barge Transport

Movement of iron ore mined in Goa to the Marmagao port of export is by barges on the rivers Mandovi and Zuari. The Cumbarjua Canal linking the two rivers is a very busy component of this network. Deepening and widening of this canal will facilitate ore movement, and will also enable a change over to 1,000 tonne barges from the prevailing 500 tonne size, resulting in significant saving in transportation costs.

4.5 Credit and Capital Financing

Short Term Credit

Short term credit for mining operations, on hypothecation of stocks, is available from many commercial banks and other financing institutions. However, difficulty of access to the mine and/or of assessment of the value of the stock (in the case of certain minerals), have made it difficult for mining operators to benefit from the existence of these financing facilities.

Capital Financing

Financing for capital expenditure is available usually for procurement of tangible assets, such as mining and transporting equipment. Mining is a complex activity requiring, for efficient operation, exploration for development of mine, opening up (or development) of the mine, installation of ore-dressing plants, etc. For many of these activities financing is not available from existing sources. The small miner requires technical consultancy, and this is not available on acceptable terms. The recent action of the Reserve Bank of India in extending its guarantee on loans to the small scale industry to the mining industry also, might ease the situation. However, it could result also in inefficient and undesirable application of the resources so released.

4.6 Mining Finance Agency

There appears to be a good case for a special agency to finance the mining activity; an essential constituent of this agency is a service for counselling the client on his information needs and on assisting him to secure the information and to reach the best decision based on it.

4.7 Fiscal Measures

Fiscal Incentives

Indian income tax laws contain few special incentives to the mining industry. In 1970, two measures improved the picture for mining. The first is a provision

for amortisation of expenditure on prospecting and mine development, with the instalment of amortisation eligible for deduction from income liable to taxation. The other provides higher rates of depreciation of investment on equipment and works, allowable for deduction from income.

In 1971, the benefits from two incentives were reduced, and the withdrawal of development rebate with effect from April 1, 1974 was announced. These affect adversely the prospects for increase in activity in mineral exploitation.

4.8 Research Institutions

Research in Mining and Beneficiation

A number of institutions in India, especially the Central Mining Research Station, the National Metallurgical Laboratory and Regional Research Laboratories, all under the Council of Scientific and Industrial Research, are active in research on mining methods, ore-dressing and improved utilisation of minerals. These research institutions have the capacity, and are keen, to meet the increased need for their services that might be generated by measures to increase, and improve the efficiency of, mining activity in the country.

CHAPTER IV—RECOMMENDATIONS

1. Exploration

1.1 There is urgent need for the Government organising, and/or encouraging the organisation in the private sector, of well equipped and competent services for detailed exploration. Needed inputs, such as foreign exchange, should be made available on high priority.

Intensive exploration should be undertaken of resources of manganese ore in order to improve the capability to meet domestic needs and export demand, and of chromite and kyanite, in order to formulate long range policies with respect to exports.

2. Mining

2.1 Technical consultancy services should be organised such that they are responsive to the needs of the mining industry, and offered under attractive terms.

2.2 Beneficiation or agglomeration of ores should be encouraged, by offering attractive financing terms or providing fiscal incentives. Investigations into the feasibility of such processes could be subsidised.

In particular, introduction of efficient ore dressing methods are essential in manganese, kyanite and chromite mining, and agglomeration is of importance in iron ore and chromite.

3. Transportation

3.1 There is urgent need, in many areas, for improvement of roads between mines and highways, rail heads or barge jetties, as the case may be.

3.2 The provision of railway freight service should be matched with the demand characteristics.

The railways should examine, on priority, the costs and benefits of laying the ten kilometre railway extension from Banspani to Joruri in the Banspani-Barajamda sector in Orissa and Bihar.

4. Marketing

4.1 Investigations into more efficient uses of minerals, and into uses for material rejected at present, should be encouraged.

4.2 As there seem to be no immediate prospects for agglomeration of fines accumulating in various mines in the eastern region, the MMTC should pursue vigorously efforts to export them.

5. Financing

5.1 The mining industry needs a special agency for financing, which also will be able to assist the client in analysing his needs and securing appropriate information and services. This agency will be in a special position, and should capitalise on the opportunity, to promote efficient mining, giving consideration to the socio-economic environment.

5.2 The mining financing agency should also be able to finance various inputs needed by the industry; for example, improvement of roads and establishment of exploration agencies.

6. Direct Legislation

6.1 More assurance should be given to miners on their tenure by making the duration of all leases 30 years and making the first renewal almost automatic at the option of the miner.

6.2 Legislation should be passed to prevent intents for public sector exploitation from interfering with existing rights and their renewal, and also their expansion if more economic and efficient exploitation is promised.

6.3 The feasibility of measures aimed at taking into consideration, in an equitable manner, the ability of an applicant to exploit the lease efficiently and at a good pace, should be examined.

7. Administration

7.1 A comprehensive study should be undertaken, first to specify the information that should be sought from mineowners on their operations, and then to devise proforma with a view to minimising the effort needed on the part of the mineowner to supply the information.

8. Fiscal Measures

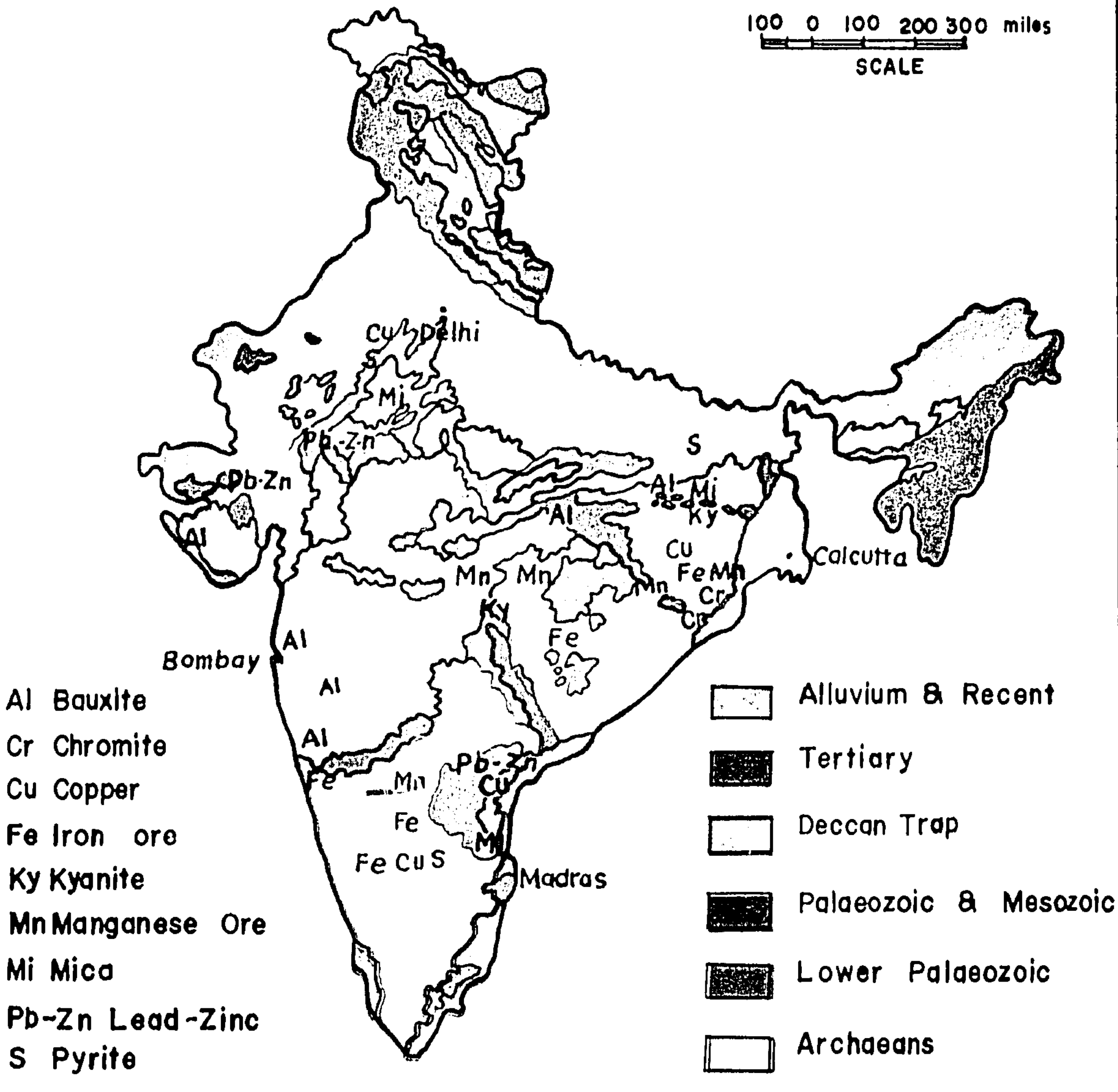
8.1 Special incentives should be given to mining in order to encourage efficient practices, such as intensive exploration, scientific planning of the operation and efficient recovery of the mineral.

8.2 In the case of minerals which, by more rapid exploitation can make quick impact on the country's economy, and in which known reserves permit it, granting of a depletion allowance should be considered.

PART II

Mining in India (by Mineral)

GENERAL GEOLOGICAL MAP OF INDIA AND PRINCIPAL MINERAL DEPOSITS



Source: (1) Progress of the Mineral Industry of India 1906-1955, M.R. Sahni.
(2) National Atlas of India, 1957.

CHAPTER I—IRON ORE

1. Introduction

Strategic Role

1.1 India ranks sixth in the world in iron ore production, the first being the USSR. Iron ore plays a strategic role in her economy. In terms of value among minerals produced, iron ore comes next to coal and petroleum. But among non-fuel minerals it takes the cap for its highest contribution to production (37%), employment (20%) and national income (25%). This industry is not export oriented to the extent that certain others are e.g. manganese mining, because of large internal requirements. Share of export in production is about 50% as compared to 80% for manganese ore. In spite of this, iron ore plays a significant role in the country's export front. It is the highest contributor (50%) to India's minerals export and provides 6% of the world's iron ore trade. In India's total export iron ore has been heading for a second place, next to jute.

2. Brief Review of World Iron Ore Industry

World Reserves

2.1 The world iron ore industry has abundant resources for exploitation. A survey of World Iron Ore Resources (1970) by the United Nations estimates the total world resources as 782,500 million tonnes (MT) out of which 251, 300 MT are indicated reserves.

2.2 Distribution of iron ore resources over the various regions of the world is uneven. While the total resources of Africa is 31,300 MT, the same is in the order of 304,300 MT in USSR (Table 2.1).

Table 2.1 : Total World Iron Ore Reserves 1967 (Region-wise)

(In million tonnes)

Region	Indicated		Potential		Total	
	Qty.	%	Qty.	%	Qty.	%
World Total	251,300	100	531,200	100	782,500	100
USSR	110,5	44	193,800	36	304,300	39
Canada & W. Indies	36,300	14	89,400	17	125,700	16
USA, Puerto Rico, Mexico & Central America	8,200	3	98,100	19	106,300	14
S. America	34,100	14	58,400	11	92,500	12
Middle East, Asia & Far East	17,300	7	54,200	10	71,500	9
Europe	21,300	8	12,800	2	34,100	4
Africa	6,800	3	24,000	5	31,300	4
Australia, New Zealand & New Caledonia	16,800	7	N.A.	—	16,800	2

N.A.—Not assessed

Source : Survey of World Iron Ore Resources, United Nations, 1970.

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Country-wise Variation

2.3 There are more than one hundred countries in the world which have some iron ore resources, with the quantity varying over a wide range. Starting from one million tonnes in China (Taiwan), it goes up to 304,300 MT in the USSR, the country having the world's largest iron ore resources (38.9%). Among the countries having large reserves, India comes seventh (3.7%), following the USSR, Canada, the USA, Bolivia, Brazil and China (Table 2.2). In the region comprising the Middle East, Asia and the Far East, she takes a share of 40.6% of the total reserves and occupies a place next to China (Mainland).

2.4 The rapid growth of the world steel industry in sixties has dictated a corresponding increase in the production of iron ore. As against a total output of 508 MT in 1962, production increased to 629 MT in 1965 and 642 MT in 1966. There was a fall in production in 1967. In the next year production resumed its upward trend and jumped to 672 MT. The world production of iron ore in 1969 was 682 MT (Table 2.3).

2.5 The USSR again takes the lead with a 27% share in the world production, followed by the USA (13%). India ranks sixth in the list and accounts for a little over 4% of the total. Among the principal countries, Australia has had a fantastic growth rate in the past seven years. Production in Australia in 1969 was four times her production in 1965. In terms of quantity, Australian production increased by 18.1 MT between 1965 and 1969, whereas Indian production increased by only 5.3 MT in the same period.

Table 2.2 : Total World Reserves and Share of Major Countries (Including India)

(In Million Tonnes)

Country	Indicated	Potential	Total	% of total
World Total	251,300	531,200	782,500	100.0
USSR	110,483	193,818	304,300	38.9
Canada	33,628	86,389	120,017	15.4
USA	7,617	97,898	105,515	13.5
Bolivia	—	42,268	42,268	5.4
Brazil	30,050	10,164	40,214	5.1
China (Mainland)	5,882	24,751	30,633	3.9
India	8,646	20,406	29,052	3.7
Australia	16,165	N.A.	16,165	2.1
France	6,525	4,500	11,025	1.4
Cuba	2,615	3,000	5,615	0.7
Other countries	29,689	48,006	77,696	9.9

N. A.—Not assessed.

Source : Survey of World Iron Ore Resources, United Nations, 1970.

Table 2.3 : World Production

Country	Average grade (%)	Production (In million tonnes)					% Share (1969)
		1965	1966	1967	1968	1969	
World Total	—	628.9	642.1	621.9	671.6	681.7	100.0
USSR	60	153.4	160.1	168.3	177.0	186.0	27.3
USA	50—55	88.9	91.6	85.5	87.0	89.0	13.1
France	32	59.5	55.4	49.2	55.2	55.1	8.1
Canada	55	36.2	36.9	38.4	44.8	36.3	5.3
Sweden	60	29.4	27.9	28.3	27.2	33.2	4.9
India	61	23.9	26.7	25.9	27.9	29.2	4.3
Australia	65	6.8	11.7	17.2	26.4	24.9	3.6
Brazil	65-70	18.2	23.3	23.5	25.2	22.7	3.3
Liberia	68	15.3	16.6	17.4	19.2	21.7	3.2
Venezuela	62	17.7	17.9	17.1	16.2	19.4	2.8
Other countries	25-66	179.7	173.9	151.1	165·4	164.2	24.1

Sources : (1) Statistical Summary of the Mineral Industry, London.

(2) Indian Bureau of Mines (IBM).

(3) UN Monthly Bulletin of Statistics.

Difference in Grade

2.6 As regards the average iron (Fe) content of iron ore produced, Brazil tops the list with a Fe content varying from 65% to 70%. Among the major producing countries France, which ranks third in production, accounts for the lowest grade (32%). In Austria, Belgium, Czechoslovakia, Germany, Hungary, Luxembourg, Poland and the United Kingdom the Fe content varies from 25% to 30%.

World Demand

2.7 The world demand for iron ore in 1969 was about 680 MT. Five countries of the world (USSR, USA, Japan, West Germany and France) were the leading consumers, accounting for 65% of the total world consumption. India's share in the world consumption was less than 2%. By 1975 the world demand for iron ore is expected to go up to 820 MT, which will call for a considerable increase in the production rate.

World Export

2.8 International trade in iron ore shows a gradual increase in the past five years. Total world trade, which was 197 MT in 1965, moved up to 254 MT in 1969, an increase of 29%. Presently there are about ten countries which export more than 10 MT of iron ore per year. In 1969, Canada, which ranked fourth in production, was the largest exporter in the world (14.5%), followed by the USSR (12.7%). It is interesting to see the share of Australia in the world iron ore

trade. This country made a very late start in the world market. In 1965 her share was negligible (0.1 MT). But in 1969 she had surpassed India and occupied seventh place (Table 2.4). India came next to Australia and her share in the world trade was 6.1%.

Table 2.4 : World Export

(Quantity in million tonnes)

Country	1965	1966	1967	1968	1969	% Share (1969)
World Total	211.5	211.0	214.4	245.3	254.3	100.0
Canada	31.3	31.2	31.9	36.6	36.8	14.5
USSR	24.1	26.1	24.6	32.2	32.2	12.7
Sweden	24.5	24.3	23.1	28.8	29.1	11.5
Liberia	15.3	16.6	17.4	19.2	18.9	7.4
France	20.8	18.2	17.5	18.3	18.5	7.3
Venezuela	17.0	17.0	16.5	15.1	16.8	6.6
Australia	0.1	0.3	5.6	12.5	16.4	6.4
India	11.3	13.7	13.6	15.6	15.6	6.1
Brazil	12.7	12.9	14.3	15.1	15.4	6.0
Chile	N.A	N.A	N.A.	N.A.	10.7	4.2
Other countries	54.4	50.7	49.9	51.9	43.9	17.3

N.A.—Not available.

Source : Statistical Summary of the Mineral Industry, London.

World Imports

2.9 The major importing countries are Japan, the USA, West Germany, Belgium, the UK, Czechoslovakia, Poland and Italy. Each of these countries imports more than 10 MT of iron ore a year. In 1969, the imports of all these countries taken together accounted for more than 77% of the total world trade (Table 2.5). Japan was the largest importer (26.8%), followed by the USA (17.5%) and West Germany (16.4%).

Demand vs. Imports

2.10 It is worthwile to note the dependence of a few major countries on imported iron ore. Nearly the entire demand in Belgium in 1969 was met by imports (Table 2.5). Iron ore imported by Japan constituted 97% of her requirements ; it was 90% for Italy. The USA, which is a major producer of steel and ranks second in world production of iron ore, imported one-third of its total demand, mainly from her neighbour Canada.

Table 2.5 : World Imports (1969)

Country	Quantity imported (million tonnes)	% share in world import	Import as % to demand
World Total	254.3	100.0	37.4
Japan	68.2	26.8	96.9
USA	44.6	17.5	33.8
West Germany	41.4	16.4	84.3
Belgium	26.5	10.4	99.6
UK	17.5	6.9	55.7
Czechoslovakia	11.5	4.5	88.5
Poland	11.1	4.4	78.1
Italy	10.1	3.9	90.1
Other countries	23.4	9.2	7.0

Source : IBM

3. Geology and Reserves in India

3.1 India is endowed with large iron ore reserves of good quality spread over a large part of the country. As exploration is a continuous process, the estimates of iron ore reserves in the country vary over a period of years. According to the estimates of the Geological Survey of India (1966), the indicated and inferred reserves are in the order of 7,594 and 21,583 MT respectively. The United Nations Survey (1970) puts these figures at 8,646 and 20,406 MT. "A Status Report on Iron Ore Development Programme", issued by the Government of India, cites indicated reserves as 9,728 MT. In the present analysis estimates of this report have been utilised.

India's Resources

3.2 Four States of the country, viz. Orissa, Madhya Pradesh, Bihar and Mysore, account for more than 90 % of the country's reserves. Goa, with 500 MT, occupies fifth place (Table 3.1). Occurrences of iron ore in these States have certain peculiarities and hence it would not be out of place to have a Statewise round-up.

3.3 Iron are reserves in Orissa are the largest in the country, the reserve figures running to 3,200 MT. Though both hematite and magnetite ores are available, the proportion of the latter type is negligible. While hematite ores occur in association with banded iron ore in Keonjhar, Sundargarh and Cuttack districts, magnetite ores are traced in basic rocks in the district of Mayurbhanj. Vast

Orissa

hematite deposits are found around Bolani, Banspani, Thakurani, Kurband, and Phuljohra in Keonjhar district, Malangtoli, Khandadhar and Koira in Sundergarh district and Tomka and Daitari in Cuttack district. Of these the most important locations are Malangtoli (738 MT), Banspani (593 MT), Bolani (489 MT), and Thakurani (353 MT). The ores are generally massive, hard, compact and dark brown to brownish black with Fe content varying from 58% to 70%. In these ores the alumina contaminant usually occurs in a larger proportion than silica, and the average percentage of phosphorous is less than 0.1.

Table 3.1 : Reserves of Iron Ore-All India and States.

State	Reserves (In million tonnes)	% Share
All India	9,728	100.0
Orissa	3,200	32.9
Madhya Pradesh	2,438	25.1
Bihar	1,680	17.3
Mysore	1,484	15.3
Goa	500	5.1
Tamil Nadu	306	3.1
Others	120	1.2

Source : A Status Report on Iron Ore Development Programme, Government of India.

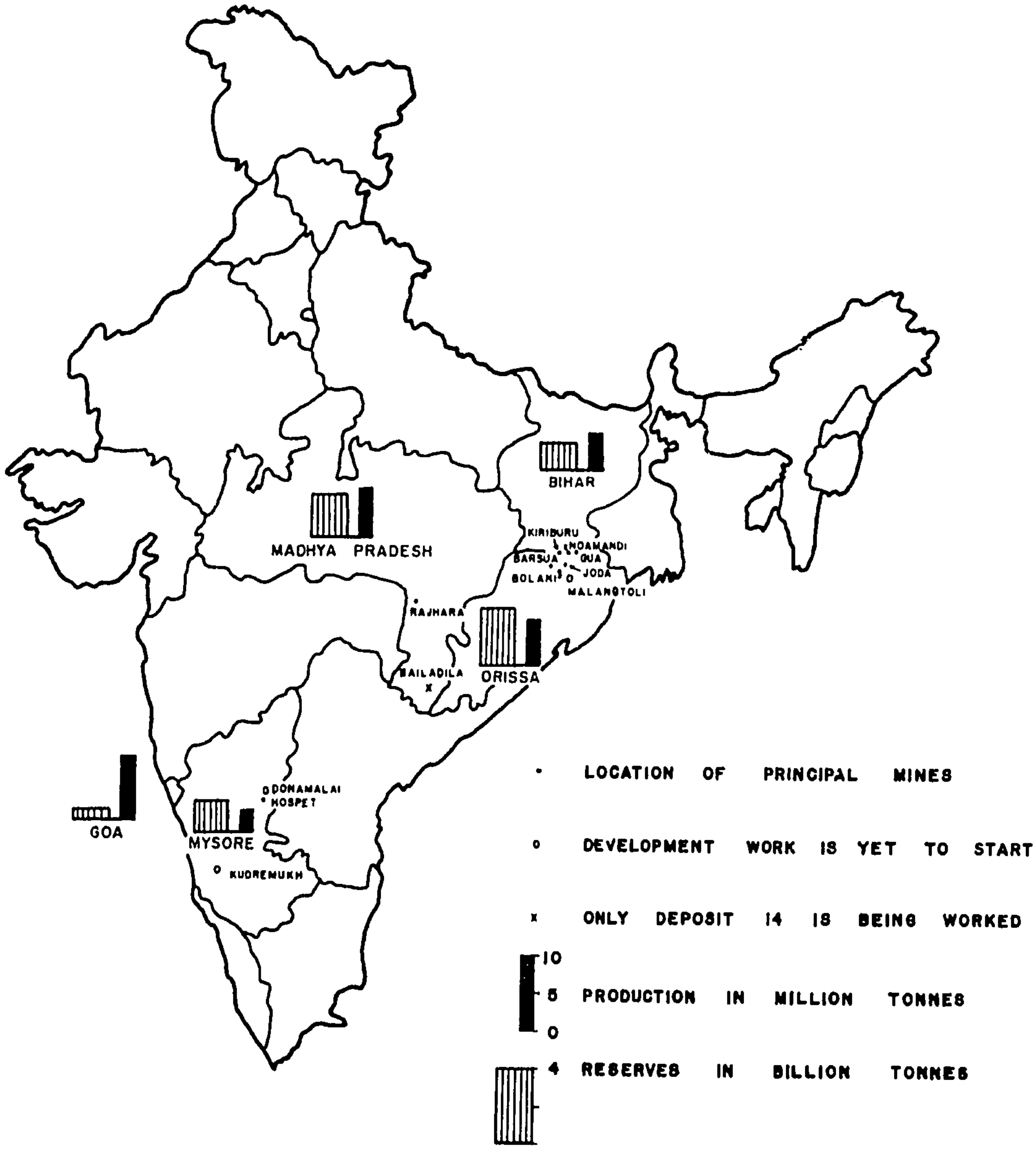
Madhya Pradesh

3.4 Madhya Pradesh, with 2,438 MT, possesses a quarter of the country's total reserves and comes next to Orissa. Almost the entire reserves is of hematite ore. Districts having high concentration of ore are Bastar, Durg and Jabalpur. The deposits in the Bailadila and Rowghat (Bastar district) and Rajahara (Durg district) areas constitute 94% of the State's reserves. The ores are of high grade, the Fe content ranging from 59% to 69%. Ores in Jabalpur district are micaceous and siliceous hematite and are generally of low grade (45-60% Fe). Unlike in Orissa, the silica contaminant is generally more than alumina.

Bihar

3.5 Bihar, which has a reserve of 1,680 MT, finds almost the entire deposit in Singhbhum district. The major areas of reserve lie in the south western part of the district which includes Noamundi, Notuburu, Kiriburu, Pansiraburu, Jamda, Manoharpur and Gua. Ore usually occurs in the banded hematite jaspers. As in Orissa and Madhya Pradesh, the share of magnetite in the total reserves is insignificant. The most important locations of hematite ore are Kiriburu (413 MT), Noamundi (295 MT), Manoharpur (284 MT) and Gua (179 MT). The characteristic features of the ores are the same as those of Orissa.

LOCATION OF PRINCIPAL IRON ORE MINES, RESERVES & PRODUCTION BY STATES, 1970



3.6 A distinctive feature of iron ore occurrence in Mysore is that the magnetite reserves, when fully explored, might prove to be larger than the hematite reserves. In the past more attention has been paid to establishing the hematite reserves. The Government of India report on which this discussion is based estimates the hematite reserves to be 1269 MT. The report cites a magnetite reserve of 215 MT. However, later investigations place the magnetite reserves at over 1000 MT.

Mysore

Hematite deposits are found in the districts of Bellary, Chikmagalur, Chitaldurg, Shimoga, Tumkur, and South Kanara. The deposits in Bellary are the most important, occurring in hill ranges known as the Bellary-Hospet ranges. The reserves here are estimated to be 498 MT of hematite ore with Fe content ranging from 60% to 67%. Hematite deposits in other districts contribute a reserve of 771 MT.

Magnetite deposits occur in association with quartzite in the Kudremukh, Aroli, Gangrikal and Gangamula ranges in the western border of Chikmagalur district. This horizon of magnetite-quartzite extends over an area 30 kilometres long and 10 kilometres wide. The reserves are estimated conservatively at over 1000 MT. The ore contains only about 32% Fe. Interest in these deposits has been aroused by the prospects of a good export market for this ore, though it is of low Fe content. The deposits are very close to the coast and export can be made at low cost, particularly by pumping the ore in slurry form directly into ocean carriers. When these reserves are fully explored, Mysore is likely to overtake other States in volume of reserves.

Goa

3.7 Iron ore is the most important mineral of Goa and is the found in the taluks of Bicholim, Sanguem and Satari. The ore is generally laminated, porous and friable. The Fe content is lower than in the hematite ores in other States ; the range is from 57% to 60%. Goa ore also contains larger proportions of fines and blue dust. It has been estimated that the ratio of fines and blue dust to lumpy ore is higher than 2 : 1. Two other varieties of ore are also found and mined, viz. manganiferous iron ore or "black iron ore" and ferrugenous maganese ore or "ferro-manganese ore". The former has about 15% Mn and a total metal content of 50%. The latter also has a total metal content of about 50% but has Mn content of about 28%.

Tamil Nadu

3.8 Tamil Nadu comes sixth (306 MT) among the States of India having iron ore reserves. The major pockets of ore are found in the Kanjamalai and Godumalai hills in Salem district. But the ores are of magnetite type with Fe content less than 50% and with very high silica content.

Other States

3.9 Other States which also have some iron ore reserves contribute a negligible percentage to the country's iron ore wealth. Very recently Kozhikode district of Kerala has been reported to have 325 MT of low grade ore of 30-35% Fe.

4. Structure of Iron Ore Mines in India

Nature of Ownership

4.1 In terms of number of mines operating, iron ore holds the fourth position among all minerals and the third among non-fuel minerals. There were 299 iron ore mines by the end of 1970. All types of ownership viz., proprietorship, partnership and joint stock company (both public limited and private limited) are prevalent. Mines in the private sector far outnumber those in the public sector. In 1970, there were 24 mines in the public sector, with participation either of the Central Government or of a State Government. Some of the important mines in the public sector are Bailadila (Madhya Pradesh) and Kiriburu (Bihar) of the National Mineral Development Corporation, Rajhara (Madhya Pradesh) and Barsua (Orissa) of Hindustan Steel Limited and Daitari (Orissa) of the Orissa Mining Corporation. Mention may be made of the Noamundi (Bihar) and Joda East (Orissa) of the Tata Iron and Steel Company, Bolani (Orissa) of Bolani Ores Ltd., Gua (Bihar) of the Indian Iron & Steel Company, Pale (Goa) of Chowgule Private Ltd., Sanquelim (Goa) and Sonshi (Goa) of Min Goa Private Ltd., in the private sector. Among all these mines the mine at Bailadila is the biggest not only in India but also in entire Asia. The present study has covered all the major mines of India including mines in the public sector. Besides, many smaller mines also have been visited.

Type of working

4.2 There is a wide variety in the size and manner of working of iron ore mines in India. A majority of the mines are on small leases. More than half of the mines in India have an individual annual production of 10,000 tonnes or less and their contribution to the country's total production is negligible. At the other end of the scale are very large, highly mechanised mines. The investment in mines ranges from a few thousands to a few crores of rupees depending upon the size of the mine, scale of operation and the extent of mechanisation.

Degree of Mechanisation

4.3 The degree of mechanisation in iron ore mines varies widely. Factors which influence mechanisation include nature of occurrence of ore, extent of overburden and demand for ore. Mines dealing with float ore normally do not require mechanisation. Their number is quite large in Mysore and Goa. On the other hand in the areas where iron ore is found in reefs, use of mechanical power is needed in drilling for blasting. Similarly, if there is heavy overburden, one has to go for some mechanisation to remove the overburden. Generally, shovels and dozers are used for that purpose. It was observed that all the fully mechanised mines of India are either captive mines or are committed to export on long term contracts. The quantity of proved reserves also has a bearing on the decision to mechanise a mine. Full fledged mechanisation involves investment running to a few crores of rupees. No mine owner will take the risk of undertaking such a venture unless he is sure that the area is rich in proved deposits which will last for a reasonable period of time. None of the mechanised mines in Goa is a captive mine. These mines have been mechanised to meet the demand from abroad. The same is the case with the two mines of the National Mineral

Development Corporation, viz. Bailadila and Kiriburu. Both these mines are at present exporting their entire produce to Japan. But these are the prospective captive mines of the projected Visakhapatnam and Bokaro steel plants respectively. The list of fully mechanised captive mines include Barsua (Hindustan Steel Ltd., Rourkela), Rajhara (Hindustan Steel Ltd., Bhilai), Noamundi and Joda (Tata Iron and Steel Co., Jamshedpur) and Gua (Indian Iron and Steel Co., Burnpur). The fully mechanised mine at Bolani, although in the private sector, despatches its entire produce to the Durgapur steel plant.

Method of Mining

4.4 Iron ore mines in India are mostly opencast. Extraction of ore is normally done in hill slopes. In non-mechanised mines which are generally small and have float ore, the entire mining is done manually. Most of the fully mechanised mines have their own crushing and screening plants while a few have provision for beneficiation. Generally the fully mechanised mines work in two shifts.

Explosives

4.5 Consumption of explosives is reported to be very high in iron ore mines. These mines account for the highest consumption of explosives in India. The explosives most commonly used are gelatine, liquid oxygen, gun powder and detonators. Besides some very high explosive (slurry explosives) such as aquaram, aquanite and aquarix are also used in some of the major mines visited. It has been observed that one tonne of high explosive can generally blast ten tonnes of rocks.

Employment Structure

4.6 The multiplicity of small mines has its impact on the employment structure. Data available from the Director General of Mines Safety show that during 1968 more than 69% of iron ore mines had a daily average employment of 150 persons or less (Table 4.1) whereas only 6% of the mines had a daily employment of more than eight hundred. These are generally big mines with a production of more than 100 thousand tonnes. The productivity per man-shift varies considerably. Starting from an average production of one tonne per man-shift in non-mechanised mines, it goes up to 4 tonnes in fully mechanised mines. Productivity in semi-mechanised mines is on an average 2 tonnes per man-shift. As regards the practice in employing labour, both direct and contract labour are equally preferred. In most area, there is a scarcity of labour during the monsoon, which results in scaling down of production. This is more so in the case of mines employing contract labour.

Accidents

4.7 It is uncommon to see accidents in iron ore mines. Mines having higher degree of mechanisation are reported to be susceptible to more accidents of fatal or serious nature. Number of fatal accidents per thousand persons employed is 0.34 in iron ore mines. As regards those causing serious injuries, the number comes to 1.40 per thousand. Fall of wall is a major cause of death in many iron ore mines whether mechanised or not. But in mines using mechanical power, injuries are are also caused by improper handling of the mechanical equipment. Supply of goggles, helmets and boots to the labourers has yet to take place in most of the mines. Violation of this provision was a common feature in the mines visited.

Table 4.1 : Distribution of Iron Ore Mines by Employment Groups (1968)

Employment Groups	No. of Mines	Percentage
Upto 50	101	39.3
51 to 150	77	30.3
151 to 250	31	12.1
251 to 400	15	5.8
401 to 500	10	3.9
501 to 800	8	3.1
801 to 1200	7	2.7
1201 to 1600	2	0.8
1601 and above	6	2.3
Total	257	100.0

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal 1968.

5. Production Trend and Grade Structure

Distribution of Mines

5.1 There are active iron ore mines in eight States, but about 84% of the mines are found in three States viz., Mysore, Goa and Orissa (Table 5.1). The structure of these mines vary widely as mentioned earlier. For example, most of the mines in Mysore and a major proportion of the mines in Goa are very small. But the mines in Madhya Pradesh, although numbering only seven, are mostly big mines.

State-wise Production

5.2 Production of iron ore in 1970 was 30.8 MT as against 29.2 MT in 1969. A cross analysis of the number of mines in a few major States and their production gives interesting results. Mysore, which accounts for 38% of the mines, contributes only 9% to the country's production and occupies the fifth place (Table 5.2). Goa, with 80 mines, is the largest contributor. More than a quarter of India's production comes from Goa. The seven mines of Madhya Pradesh account for as high as 23% of the total production.

5.3 Production of iron ore shows an increasing trend over the last ten years. As against 16.5 MT in 1960, the present production is 30.8 MT, a growth of 87%. A year-wise analysis indicates that exeept in 1967 there has been no fall in the production of iron ore. This fall, by about 1 MT, is mainly due to a fall by an equal quantity in Orissa.

Table 5.1 : Number of Iron Ore Mines Operating During 1966-70—All India and Major States

State	1966	1967	1968	1969	1970 No.	1970 %
Mysore	86	71	65	116	113	37.8
Goa	91	91	85	80	80	26.7
Orissa	49	52	48	54	58	19.4
Bihar	40	34	34	34	23	7.7
Madhya Pradesh	NA	9	8	9	7	2.3
Andhra Pradesh	NA	14	13	14	10	3.3
All India	299	273	257	312	299	100.0

Source : (i) DGMS—Statistics of Mines in India, Vol-II, Non-Coal, 1966, 1967 and 1968.
(ii) IBM —Mineral Statistics of India, Vol II, January 1971.

Declining Trend in Orissa, Bihar and Mysore

5.4 Among the major producing States, a declining trend is noticed in Bihar, Orissa and Mysore. Production in Madhya Pradesh and Goa shows a gradual increase. The main reason for the decrease in production in the first two States is stated to be falling demand. During our visits to the mines in these States it was reported that making any plan to increase production is hindered by the uncertainty in demand for the ore. Presently no mineowner except those in Goa can export ore directly as it has become the monopoly of the Minerals and Metals Trading Corporation (MMTC). For internal consumption, a mineowner can have direct contact with only the private sector steel plants. The steel plants in the public sector usually prefer to purchase through the MMTC. In this connection it may be mentioned that all the steel plants in the private sector have their own captive mines and their requirements from outside are small. This has restricted the internal market for non-captive mineowners whose number is quite large in these States. As regards export, these mineowners have to depend upon the MMTC. It is reported that the quantities taken by the MMTC are not commensurate with their production capacities. This has resulted in fall in production. As regards Mysore, most of the mineowners had been mining float ore. It is reported that these float ores are almost exhausted and time has come to mine the reefs by open pit methods in the bed rock. This requires financial investment which is beyond the capacity of most of the small mineowners.

5.5 The conditions are different in Madhya Pradesh and Goa. The majority of the mines in Madhya Pradesh are captive mines of Bhilai. So far as Bailadila is

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Table 5.2 : Production of Iron Ore During 1961-70

All India and Major States

(In million tonnes)

Year	All India		Goa		M. P.		Orissa		Bihar		Mysore	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%	Qty.	%	Qty.	%
1961	17.8	100.0	6.4	36.0	2.3	13.0	4.7	26.4	2.0	11.5	1.7	9.5
1962	19.1	100.0	6.1	32.2	1.9	9.8	5.4	28.6	3.0	15.8	2.3	12.2
1963	21.1	100.0	5.5	26.1	2.3	11.1	6.0	28.4	3.5	16.4	2.6	12.1
1964	21.9	100.0	6.1	27.6	2.9	13.2	5.7	26.1	3.7	16.7	2.6	11.6
1965	23.9	100.0	6.7	28.0	2.8	11.6	6.7	28.1	4.3	17.9	3.0	12.5
1966	26.7	100.0	6.7	25.0	4.0	14.9	6.8	25.6	5.4	20.2	3.4	12.7
1967	25.9	100.0	6.8	26.0	4.6	17.6	5.7	22.0	5.4	20.8	3.1	12.1
1968	28.0	100.0	6.9	24.5	5.4	19.3	6.1	22.0	5.7	20.5	3.4	12.3
1969	29.2	100.0	7.7	26.2	6.4	21.9	6.6	22.7	5.3	18.3	2.8	9.6
1970	30.8	100.0	8.8	28.5	7.2	23.3	6.2	20.4	5.1	16.6	2.9	9.4

Source : IBM—Mineral Statistics of India, Vol. II, January 1971.

concerned. long term agreements have been made with Japan to export increased quantity of ore which necessitates enhancing the production rate. As regards Goa the mineowners have been left free to negotiate with foreign firms directly for supplying ore. Some of them have long-term contracts. These considerations account for the increase in production in these States.

Public Sector Vs. Private Sector

5.6 The public sector, which has only 24 mines at present, contributes substantially to the country's total production. Out of the present production of 30.8 MT, 11.8 MT (38.3%) comes from this sector. Production in this sector shows an uninterrupted increasing trend (Table 5.3). Within a period of five years (1966-70) production has registered a growth of 80%, that is to say, an increase of 16% per annum. During this period production in the private sector registered a net decrease, though small. The obvious reason for the few public sector mines contributing a substantial quantity is their size. Mines in the public sector are generally bigger in size and the degree of mechanisation is also higher as compared to mines in the private sector. Bailadila, the largest public sector mine, contributes one-third of the production in the public sector.

Table 5.3 : Production of Iron Ore During 1966-70—Public Sector and Private Sector
(In million tonnes)

Year	Total		Public Sector		Private Sector	
	Qty	%	Qty.	%	Qty.	%
1966	26.7	100.0	6.6	24.7	20.1	75.3
1967	25.9	100.0	6.8	26.3	19.1	73.7
1968	28.0	100.0	9.5	33.9	18.5	66.1
1969	29.2	100.0	10.4	35.6	18.8	63.4
1970	30.8	100 0	11.8	38.3	19.0	61.7

Source : (1) IBM—Mineral Statistics of India, January, 1971.
(2) ORG Mineral Survey.

Ratio of Fines to Lumps

5.7 Production of fines (below 6 mm) on an average amounts to one tonne out of every three tonnes of ore mined. But among the States there is wide variation in this ratio. Goa produces the maximum quantity of fines. Two out of very three tonnes mined are fines. In Madhya Pradesh about 40 to 50% of ore production is in the form of fines. In Orissa and Bihar share of fines varies from one quarter to one half of the production. With the same physical structure of ore, amount of fines is more in mechanised mines as compared to non-mechanised mines.

Grade

5.8 As regards the grade of ore, Goa is the only State where the average Fe content of most of the ore produced is below 60%. Only the Sancordem zone of

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Goa produces ore with more than 60% Fe content. In other States ore with Fe content less than 60% are either blended with high grade ore so as to bring the average content higher or rejected as waste.

6. Processing of Iron Ore

Necessity for Processing

6.1 There are important grounds for consideration of methods for processing the mined ore before marketing it. Firstly, the chemical composition of iron ore is not uniform in all areas. While some areas are endowed with high grade ore, others suffer from lack of such quality ore. These low grade ores need not be treated as waste as several methods are available for making them marketable. France, which is one of the leading producers of iron ore as well as steel, has iron ores of very low grade, the average Fe content varying from 30—35%. But in India, except in Goa, ores with Fe content below 60% are either blended with high grade ore or rejected as waste. This need not be so. Secondly, a substantial portion of ore production occurs as fines. Although the fines might possess the required Fe content, no use can be made of them without agglomeration. Instead of going for high grade lumpy ore these fines can be suitably concentrated for use in steel production. Further, use of these agglomerated fines have certain additional advantages which have made them very popular in recent years. Finally, for the use in blast furnace, the ore has to satisfy a few conditions. For example, high alumina content in the ore adversely affects the operation of blast furnaces to a great extent. All these call for upgrading the low grade ores and agglomerating the fines.

Beneficiation

6.2 The only way of raising the grade of ore is by adopting the process of beneficiation. Washing has been considered as the earliest method of beneficiation. With the passage of time research has bought to light quite a few other methods. These are heavy media separation, jigging, drying, floatation and magnetic and electrostatic concentration. In India beneficiation is at present confined to a few mechanised mines where the grade of ore is lower than the required grade. Goa has the maximum number of beneficiation plants in the country. The four beneficiation plants of Goa have a throughout capacity of 8500 tonnes of run-of-mine ore per day. Ore is also beneficiated at the Barsua mine of Hindustan Steel Ltd. The increase in the iron content of ore after beneficiation is generally 3 to 4%. Beneficiation, by increasing the iron content and reducing the percentage of impurities, facilitates smooth operation of the blast furnace.

Agglomeration

6.3 Agglomeration of fines has been gaining wide popularity all over the world. With the depletion of high grade ores and the development of agglomeration processes, modern blast furnaces are being designed to run even on a near hundred per cent feed of sinters or pellets. There are actually four methods of agglomeration viz., nodulising, briquetting, sintering and pelletising. Out of these the last two have been favoured by the iron and steel industry all over the world.

6.4 Sintering has been in vogue in the world for nearly half a century. This has been considered as the most successful of all agglomerating processes. The major advantages of using sinters in the blast furnace are smooth furnace operation, higher production and reduction in coke consumption rate. Research studies in United States have revealed that when the percentage of sinter in the blast furnace feed was increased from 47% to 68%, output went up by 19% and coke consumption was reduced by 20.7%. Besides, there was a grand reduction by 57% of flue dust in blast furnace. The sintering process has also proved to be a means of providing the blast furnace with a fluxed agglomerate. With addition of limestone to sintering mix, fluxed sinters are produced and with the use of such sinters, limestone adddition at the blast furnace has been practically eliminated, leading to further improvement in furnace productivity.

Sintering

6.5 Sintering of iron ore fines started in India only in 1959 with the establishment of a sintering plant at Jamshedpur by the Tata Iron and Steel Company to produce straight sinters. Further progress was made in 1961 when the sintering plant at Bhilai was established to produce fluxed sinters. At present there are five sintering plants in the country. All the steel plants in the public sector have such plants. Experience in the use of fluxed sinters supports the case for using more of these processed ores. Production in steel plants using sinter feed has gone up by 64% and there has been a reduction in the consumption of coke by 33%. Another effect of using fluxed sinter has been reduction in slag volume. Preparation of sinters is also economical as the raw materials used for it are classifier fines which otherwise would have been thrown away and by-products of the steel plant such as flue dust, mill scale and coke breeze. Limestone fines (—3mm) can be suitably added to get fluxed sinters.

6.6 Although the process of pelletising iron ore dates back to 1913 when it was succeesfully experimented on in Sweden, commercial utilisation of pellets was initiated in America in 1948 by Armco Corporation with the establishment of the first ever commercial plant. World production of pellets has been rising fast with increasing demand. As against 52 MT in 1955, the present world pellet production is expected to be of the order of 190 MT. Pelletising is sometimes considered as an advanced system of sintering. Though the cost of production is estimated to be higher than in sintering yet pellets have two distinct advantages over sinters. Firstly, the sintering process is not suitable for agglomerating fines and concentrates below 100 mesh, as introduction of such fines would markedly reduce permeability of the charge and strand output. It has been observed that blue dust up to 25% can be conveniently incorporated in the sinter mix. Any further increase will adversely affect the permeability of the sinter bed. Such fines which cannot be sintered can very well be pelletised. Secondly, sinters cannot be transported over a long distance as that causes altrition of sinters, thereby making them unsuitable for charging into the blast furnace. This is the main reason why sintering plants are generally attached to the steel plants. Pellets, being harder and more compact material can be transported over any distance.

Pelletisation

6.7 In India pelletising of iron ore began as late as 1967, when a pelletisation plant was set up in Goa with a production capacity of 0.5 MT per year. Presently, another pelletisation plant has been installed at Noamundi (Bihar) by the Tata Iron and Steel Co. Ltd. This plant, with an annual capacity of 1 MT in two strands, will go into production soon. Five more pelletisation plants are under consideration by various parties. Establishment of these plants will have many desirable effects. It will provide the mineowners an outlet to market the fine ores, help the country to earn more foreign exchange as the unit realisation from pellets is more than that from lumps and fines, and increase the usable reserves of the country.

7. Cost* and Price Structure

7.1 Extraction of iron ore has two distinctive features which affect the mining cost. Firstly, occurrence and quality of iron ore can be known with more certainty than, for example, chromite or manganese, Secondly, the ratio of ore to rejects and waste is generally higher in iron ore mining than that in the other two minerals mentioned above. Both these features contribute to making mining cost of iron ore less than the costs incurred in extracting manganese ore or chromite.

7.2 It was observed that mining cost of iron ore does not vary much from mine to mine, contrasting with the case in manganese ore mines, in which the range is very wide. Hence analysis of mining cost data has been done on average basis, whereas in manganese ore cost data have been presented minewise. A separate analysis has been made to compare the costs of mining in the public sector and the private sector.

Mining Cost

7.3 Mining cost of iron ore shows a gradual increase over the past five years, although the increase is in no way spectacular. The average mining cost in 1970-71 is Rs. 5/- per tonne as against Rs. 4.54 in 1966 (Table 7.1). One of the major components of mining cost is wages. The minimum wage rate fixed for iron ore mines is almost double the rate prevalent in manganese and chromite mines. One of the reasons put forward for this difference is that since the production per manshift is higher in iron ore mines a higher wage rate will not affect the unit cost very much. But this does not appear to be a sound justification when we see later the unit realisation in iron ore as compared to manganese ore or chromite.

*In the analysis three types of cost have been used viz., mining cost, f.o.r. cost and f.o.b.t. cost. Mining cost includes amounts spent on labour, technical personnel, explosives and other consumables directly related to production, while f.o.r. cost includes mining cost and all expenditure incurred till the ore is loaded on rail ; f.o.b.t. cost takes into account f.o.r. cost plus freight charges, port handling charges, export duties etc.

7.4 Although the difference in the mining cost between public sector and private sector mines is not great, cost in the private sector mines has remained lower than in the public sector mines during all the five years for which cost analysis has been made. It is generally thought that mechanisation, which brings with it economies of scale, leads to reduction of cost and hence cost of mining in mechanised mines will be less than the cost in non-mechanised mines. In the present survey, teams visited all the mechanised mines of the country and cost data for quite a few of them have been obtained.

Mining Cost in Public Sector and Private Sector Mines

It is observed that mechanisation can bring down cost if equipment availability is good and the plant works to full capacity. But many of such mines have been working below their capacity and mechanical trouble and power failure have been cited as reasons. This is probably why the mining cost in mechanised mines does not appear to be lower than in non-mechanised mines in all cases. There are instances where the mining cost in a non-mechanised mine is lower than in mechanised mines. However, the case for mechanisation in India rests more on the increase in production it can bring about than on reduction of mining cost.

Table 7.1 : Mining Cost of Selected Mines

(Rs. per tonne)

Year	Public sector	Private sector	Total
1966-67	4.24	2.84	4.54
1967-68	4.64	3.28	3.96
1968-69	4.43	4.00	4.21
1969-70	5.15	4.03	4.59
1970-71	5.98	4.13	5.05

Source : ORG Mineral Survey.

7.5 In spite of the closeness in the mining cost of iron ore mines, f.o.r. cost in the surveyed mines varies widely. This is noticed even among the mechanised mines and mines in the public sector. This variation is accounted for by differences in establishment costs, capital investment and transportation costs. Therefore, f.o.r. costs have been presented individually for a number of mines surveyed (Table 7.2). It may be mentioned that in the case of captive mines and mines having f.o.b.t. contracts no f.o.r. price has been given.

7.6 F.o.r. cost in fully mechanised public sector mines vary from Rs. 9/- to Rs. 23/- per tonne. In the case of public sector mines which are not fully mechanised the range is wider, the range of variation being from Rs. 10/- to Rs. 26/-. F.o.r. costs in private sector mines do not show much variation. The minimum and maximum limits of cost are Rs. 11/- and Rs. 16/- respectively.

Table 7.2 : F. O. R. Cost and Price of Selected Mines

(Rs. per tonne)

Sl. No.	Type	1966-1967 Cost	1966-1967 Price	1967-68 Cost	1967-68 Price	1968-69 Cost	1968-69 Price	1969-70 Cost	1969-70 Price	1970-71 Cost	1970-71 Price
1	P/M	—	—	—	—	—	—	21.05	—	22.53	—
2	P/M	16.60	—	16.38	—	15.33	—	9.10	—	—	—
3	P/N	9.87	16.81	15.24	16.33	11.73	18.50	—	—	—	—
4	P/M	11.59	—	11.85	—	12.41	—	14.02	—	13.60	—
5	P/M	—	—	—	—	24.20	—	24.46	—	21.39	—
6	P/N	—	—	22.60	—	21.38	—	26.02	—	26.02	—
7	PT/N	11.79	15.22	11.23	13.77	13.11	16.88	14.42	16.91	14.01	16.80
8	PT/N	12.83	15.22	11.77	13.77	14.61	14.61	15.81	16.91	15.24	16.80
9	PT/N	13.32	15.09	13.36	14.42	14.61	15.18	16.03	17.75	—	—
10	PT/M	—	—	11.42	—	11.63	—	12.72	—	13.06	—

Source : ORG Mineral Survey.

P = Public Sector   PT = Private Sector

M = Fully mechanised including crushing, screening and loading

N = Not mechanised. F.o.r. price for serial no. 1 and 2 has not been given as the contract is on f.o.b.t. In case of serial nos. 4, 5 & 6 no realisation data has been given as these are captive mines. For serial no. 10 no price data are available.

7.7 The difference between f.o.r. cost and f.o.r. realisation is very low as compared to many other minerals. Mineowners reported that they have been facing great difficulties in carrying out iron ore mining. While the selling price has not changed much, there has been considerable increase in the price of machinery. Further, the minimum wage fixed for iron ore mines is higher than for many other minerals. Data on mining costs prior to 1966-67 are not available to compare such differences. Nevertheless an idea of the burden that could have been imposed on the mineowners as a result of increase in the price of machinery and wages can be obtained from the percentage increase of such prices in 1970 over 1962 (Table 7.3).

Unit Realisation Very Low

7.8 Although the f.o.b.t. price is three to four times the f.o.r. price, its margin over f.o.b.t. cost is very nominal. The reasons for such low margin are high freight rates, transportation cost by road, port charges and export duties. Railway freight charges and transportation charges by road constitute 30 to 50% of f.o.b.t. costs. The export duty which has been imposed in the wake of devaluation (1966) accounts for about 15% of the sale value. The tax benefit of 10% on export of iron ore fines, which was available prior to devaluation, has since been withdrawn. It was gathered from the mineowners that in spite of the prospective improvement in the economics of export of iron ore, as a result of the development of port capacity for deep draft bulk carriers and installation of facilities for mechanical loading, it may be extremely difficult for Indian ore to continue to bear the incidence of the export duty and withdrawal of the tax benefit and yet remain competitive in the world market.

F. o. b. t. Price

Table 7.3 : Percentage Increase in the Rates of Mining Machinery, Wages, etc.

Items	% increase in 1970 over 1962
1. Fuel	166—238
2. Explosives	60—120
3. Shovels	137
4. Dumpers	62
5. Earthmover tyres	102—156
6. Wagon drills	69
7. Compressor	47
8. Tipper Trucks	104
9. Barge	300
10. Hand Tools	44
11. Wage for male	135
12. Wage for female	291
13. Other wages	209—228
14. Interest rate on bank finance	50
15. Stevedoring charges	248

Source : ORG Mineral Survey.

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8. Marketing and Transportation

Internal Consumption

8.1 The internal consumption of iron ore depends on the intake of iron and steel mills. It is pertinent to see the trend in the internal demand for iron ore. By the end of the Second Plan (1960-61) consumption of iron ore in India was about 7 MT as against a production of 17 MT. Internal demand got an impetus with the establishment of new steel mills in the public sector during the Third Plan. By the end of the Third Plan (1965-66) consumption of iron ore in the country was almost twice that in 1960-61. But since then there has been no appreciable increase in consumption. The present internal demand for iron ore is estimated to be 14 MT. This is less than half of the country's production.

Export

8.2 The trend of India's iron ore export shows a gradual increase. As against 12 MT in 1965-66 export of iron ore went up to 16.5 MT in 1969-70, an increase of 34% (Table 8.1). This increase, even in absolute terms, appears dismal when compared with that achieved in Australia ; Australian export increased from 0.1 MT in 1965 to 16.4 MT in 1969. In other words, Australia with a practically non-existent base, increased its exports by four times as much as India did on a large base.

Share of iron ore concentrates in the total export is very low. Concentrates are at present exported only from Goa. Japan is the largest importer of ores from India, accounting for more than 80% of India's export in 1969-70. Other countries which import at least 100 thousand tonnes of iron ore from India in one year are Rumania, Poland, Czechoslovakia, Belgium, the Federal Republic of Germany, Yugoslavia and the United Kingdom.

Problems

8.3 The major problems of marketing faced by this industry have been lack of a cheap transport system, adequate number of wagons and proper port facilities. Besides, the problem of getting a market for the ore has been voiced by a large number of mineowners in a particular region of the country.

Table 8.1 : Export of Iron Ore During 1965-66 to 1969-70

Year	Quantity (Million tonnes)
1965-66	12.3
1966-67	13.4
1967-68	13.7
1968-69	15.7
1969-70	16.5

Source : Monthly Statistics of Foreign Trade, Government of India.

8.4 Distance to the nearest railway station and lack of a good approach road are the two problems faced by the industry with regard to transportation of ore to the loading points. Most of the fully mechanised mines of the country, except in Goa, have not only railway sidings near the mine, but also have mechanical loading facilities. But there are a large number of mines which are away from the nearest railway sidings ; the distances vary from 5 kilometres to 50 kilometres. This leads to high transportation costs. It is noticed that the transportation cost from the mine to the railway station ranges from 30% to 40% of the f.o.r. cost. In this connection two alternatives can be advocated to bring down the cost of transportation. Firstly, the existing approach roads from the nearest highways need improvement. It is estimated that such an improvement can lower the road transportation cost by as much as 30% of the present rate. Secondly, since cost of transporting ore by rail is less than cost of transporting by road, extension of the existing railway links in certain areas, where there are concentrations of mines and large quantities of ore are transported, can reduce costs to a great extent.

Lack of Good Transport Facility

8.5 Shortage of railway wagons has become a chronic problem and this has been adversely affecting the industry. Inadequate supply of wagons has led to large amounts piling up at the loading points. Where the contract entered into by the mineowners (excluding captive mines) with MMTC is on f.o.r. basis, piling up of stock at the railhead means blocking the flow of finance to the mineowners, affecting their day to day working. Further, if ores are stocked for a longer period, the extent of loss is more. The MMTC, realising this problem of the mineowners, has started receiving ore on ex-plot basis. Under this agreement, the mine owners are to transport ore to the railway siding and give delivery of the ore to MMTC in its plot. But here too, the stock at many points had become so huge that MMTC could not take further delivery in its plot.

Shortage of Wagons

8.6 The nominal capacity quoted as available in Indian ports for export of iron ore makes it appear that port facilities are adequate. The present total capacity of the ports in India is about 22 MT as against an export of 21 MT (1970). The major deficiencies of the present port facilities are lack of sufficient provision to handle carriers above 30,000 tonnes and to complete loading in time. Export of ore in 100,000 tonne carriers is more economical and preferred by the importers. Australia and Brazil, from whom India has been facing tough competition, have port facilities to handle 100,000 to 200,000 tonne carriers. The present loading facilities available in India's ports are not always adequate, resulting in payment of huge amounts towards demurrage. It is reported that sometimes the amount of demurrage paid goes up to Rs. 15,000/- in foreign exchange, per day of detention. This is one of the main reasons why even Australia, a late starter in the field of iron ore mining, has stolen a march over India in exports. Facilities for better handling are the felt needs of the industry to enable it to be competitive in the world market.

Port Facilities Inadequate

8.7 There has been great dissatisfaction, among a majority of the mineowners (non-captive mines) in the Banspani-Barajamda sector, the main area of iron

ore mining in Orissa and Bihar, with the operations of the MMTC. As the MMTC has the monopoly in export and also handles a large part of the purchases of the public sector steel plants, most of the mineowners have to depend on the MMTC as their sole outlet. In the past years, MMTC is reported to have limited its purchases, and allocated quotas to the various producers. The mineowners complain that there seemed to be no rationale in the allocations, that they were grossly out of proporation with the production capacities of the mines. The quotas are fixed only for one year at a time, leaving the mineowners in uncertainty about organising the scale of their activities. Mineowners have also stated that whereas formerly they had been able to find foreign markets for blue dust, MMTC has not done so, resulting in large stockpiles of the material.

When queried on the quotas, MMTC contended that quotas were imposed only for one year, and that these were based on the previous year's production. It was stated that the quotas were lifted in 1970 and that the MMTC was prepared to buy any amount that the mineowners could produce. The disruption of railway freight movement due to the law and order situation in the eastern sector is reported to be the only bottleneck. The MMTC will take up any amounts the mines can produce in the future, and therefore the mineowners should be in no uncertainty regarding planning their future operations.

With respect to the export of fines, it is stated (on behalf of MMTC) that the total export of iron ore prior to the advent of MMTC in 1957 was small and the amount of fines out of this total could not have been significant. The MMTC has been negotiating with Japanese buyers, since 1969, for marketing the fines. MMTC expects to enter into a sizeable contract for the export of fines by the middle of 1972. The Bokaro steel plant, now under construction, will also use fines to the extent of about 2 MT per year.

Lack of Co-ordination

8.8 There is another problem which the present iron ore industry in India has been facing. This is the lack of co-ordination between transport and shipping. The Report of the World Bank on Economic Situation and Prospects of India says that the Indian effort is broken up by separate jurisdictions for mining, transport and port operations. A recent study team of the National Mining Operations in Canada, Peru and Brazil has recommended a single agency to control iron ore export from mine to marketing.

9. Future Prospects

Estimates of Demand

9.1 The Fourth Five Year Plan envisages a target of raising the production of iron ore to reach 51.4 million tonnes by 1973-74. On the basis of targets fixed for the production of pig iron, the internal demand for iron ore is expected to go up from the present level of 14 MT to 20 MT, thereby leaving a balance of 31 MT for export by the end of the Plan. The present level of production being 30.8 MT, an addition of 20.6 MT within a period of four years appears to be a herculean task. With this as the background, it is necessary to make an

analysis of the present set-up in order to see whether the industry can meet the ensuing challenge.

9.2 In the field of production, the public sector will play an important role. In this connection the part played by the National Mineral Development Corporation, a Government of India undertaking, is significant. At present the two mines of the corporation contribute 17% of India's total production. The corporation has a vigorous plan to raise its production by increasing the present capacity of its mines and opening up new mines. NMDC

9.3 Out of the two existing mines of NMDC, the mine at Kiriburu has almost reached its production capacity. But the mine at deposit 14 of Bailadila has been working below capacity by about 1.5 MT. The future plan for these mines lies in utilising the existing capacity of Bailadila and expanding the present capacity of the mine at Kiriburu. The Government of India has already approved the expansion and modification scheme of the Kiriburu mine so as to raise its production capacity from 2 MT per year of sized ore to 4.5 MT. The estimated capital investment involved in this project is Rs. 124.1 million This mine will be the captive mine of the Bokaro Steel Plant. The expansion is likely to be completed by the middle of 1973.

9.4 Other projects of the NMDC which are now under construction include development of deposit No. 5 in Bailadila and establishment of an iron ore mine at Donimalai (Mysore). The mine at Bailadila (deposit No. 5), with a capital outlay of Rs. 363.5 million, is expected to produce 4 MT per year of sized ore for export to Japan. Production in this mine may start by early 1974. The mine at Donimalai has a targeted production of 3.50 MT of lump ore and saleable fines with a total capital cost of Rs. 194.6 million.

9.5 One of the new fields, in which the corporation has entered very recently, is the development of the large magnetite iron ore deposits at Kudremukh in Mysore. This will be a bold attempt, being the first of its kind in India. The project is being developed by NMDC in collaboration with the Marcona Corporation of the USA and three Japanese trading organisations viz., Mitsui & Co., Nissho Thai & Co. and the Okura Trading Co. The capital expenditure, which has been estimated to be Rs. 1,900 million, will be shared by the three parties in the proportion of NMDC 51%, Marcona 25% and the Japanese consortium 24%. The Government of India has yet to take a decision on the product pattern, i.e. whether Kudremukh will produce slurry or sinter feeds or pellet feeds. Besides, a decision on the investment in the project is pending detailed scrutiny by the cabinet.

9.6 The corporation is also engaged in exploring the feasibility of setting up pelletising plants for iron ore fines and blue dust from Bailadila and Donimalai. There are a couple of other public sector mines whose production plans are also worth mentioning. These are Daitari (2 MT) of Orissa Mining Corporation and Dalli (2.5 MT) of Hindustan Steel Ltd.

9,7 On the basis of these future production plans, iron ore production in the public sector by 1973-74 is expected to reach the level of 26 MT at the maximum. Taking into account the present production of the private sector at 19 MT, an additional production of 6.4 MT is expected from the private sector. Now the question is whether it will be able to gear up production so as to reach this ambitious target.

Contribution from Public Sector

9.8 A review of the past performance of the public sector shows that during the five year period ending 1970, production in the public sector has registered an average growth rate of 16% per year, the maximum increase being in 1968. In order to achieve the production target for 1973-74 an average annual growth rate of 32% is necessary. As already stated most of the new public sector mines are expected to start production by the end of 1973-74. However, past experience points to the need for determined and concerted action not only towards completion of the plants in time but also towards the setting up of an organisation that will be capable of bringing the plants up to their optimum capacity quickly. In none of the public sector projects has full utilisation become possible in the first few years of production. In view of past experience a delay in the achievement of the targeted production is not unlikely.

9.9 As regards the private sector, production over the past five years does not show much change. Rather, production (19 MT) in 1970 is one million tonnes less than the production in 1966. With this trend in view, an additional production of 6.4 MT within a period of four years is by no means an easy task. Our discussions with the big mineowners of the country indicate that their additional production, including lump ore, fines and pellets, will be about 3.5 MT. In order to get another 3 MT of production, either new mines should be opened or further expansion of the existing mines may be done. In either of these cases substantial financial investment is necessary and unless outside financial assistance is given, it is doubtful whether the private sector will be able to fulfil the requirements.

9.10 On the assumption that by 1973-74 India will have 31 MT of ore left for export, it is necessary to see whether she will be able to export this quantity with the facilites that are likely to be available by then.

Export

9.11 Export of iron ore has shown a tremendous increase in 1970. As against 15.08 MT in 1969, the export figure reached 21.24 MT in 1970, an increase of 41% in a single year. This being the fact one might be optimistic of reaching the level of 31 MT by 1973-74. But, are the transport and handling facilities at ports adequate to handle such quantities ?

9.12 The present capacity of the Indian ports to handle iron ore is 22.30 MT. The Marmagao port in the Union Territory of Goa has the highest capacity (8 MT) followed by Vishakhapatnam (6 MT) and Paradip (4 MT) (Table 9.1).

The Planning Commission has envisaged the expansion of a few ports and construction of Haldia Port so as to raise the port capacity for handling ore to 32.60 MT by 1973-74 (Table 9.1). This comprises installation of modern ore handling facilities at Marmagao and Madras harbours and construction of an outer harbour at Vishakhapatnam for handling deep draft ore carriers, initially upto 100,000 tonnes and ultimately upto 200,000 tonnes.

9.13 Recent developments indicate the growing inadequacy of port facilities at Madras, Vishakhapatnam, Haldia and Marmagao ports. There are firm indications that with the exception of Paradip, hardly any of the port expansion schemes are expected to be completed in time to permit increased ore handling. Expanded and modernised harbour facilities at all the major ore handling ports are expected to be available only in 1974-75. As per recent findings of Major Port Commission Traffic Projections exports in 1973-74 are not expected to be more than 25.5 MT.

Table 9.1 : Present Capacity and Future Expansion of Ports in India to Handle Iron Ore

(In million tonnes)

Port	Present Capacity	Capacity in 1973-74	Year of Completion
Total	22.30	32.60	—
Haldia	Nil	3.00	1972-73
Paradip	4.00	4.00	—
Vishakhapatnam	6.00	10.00	1973-74
Madras	2.70	5.00	1973-74
Marmagao	8.00	10.60	1973-74
Other Ports	1.60	Nil	—

Source : Planning Commission, Government of India.

9.14 Taking a perspective view of the development of this industry beyond 1973-74 one notices bright prospects ahead. The world demand for iron ore is expected to touch the level of 820.4 MT by 1975. With the closing of Swedish mines owing to exhaustion, Indian ore is likely to become more competitive. Very recently Rumania has shown interest in the low grade (30 to 35%) ore of Kozhikode of Kerala which can be upgraded to 60 to 65% with modern techniques. Similarly Japan has shown great interest in purchasing a major portion of the slurry expected to be produced from the gigantic Kudremukh project. If things go well by early 1975 it may be possible to export 7 MT of slurry followed by sinter feeds and pellets. All these recent developments have opened a new vista for the growth of the industry. It is stated that with the existing resources India can meet both internal demand as well as exports for more than two centuries even at the rate of 125 MT per annum. Everything turns on whether she can utilise this advantage to the fullest extent.

Prospective View

CHAPTER II—CHROMITE

1 Introduction

Minor Role

1.1 India occupies the sixth place in world's chromite production, the first being the USSR. But chromite plays a minor role in India. In terms of value of production it stands fifteenth among minerals, by accounting for only 0.3% of the total. Among non-fuel minerals too it contributes only 1.5% of production and 1.3% of the addition to national income. In the country's total export, share of chromite is negligible. However, about 1.5% of mineral export goes to the credit of chromite. Until recently this industry was mainly an export-oriented one because of low domestic consumption. With the establishment of ferro-chrome plants, the domestic consumption in recent years has substantially increased. Presently, export of chromite constitutes about 50% of its production and this is 3% of the total world trade.

2. Brief Review of World Chromite Industry

World Reserves

2.1 Unlike iron ore, chromite has been considered as a scarce resource. The total world reserves of chromite is estimated to be 2,703 MT as against 782,500 MT of iron ore. Thus the total world chromite reserves are only 0.35% of the iron ore resources. On the other hand, the world demand for chromite in 1969 was 0.78% of the demand for iron ore (5.3 MT vs. 680 MT). Therefore, the world's reserves of chromite are being depleted relatively faster than those of iron ore.

Countrywise Variation

2.2 Only a few countries have substantial known reserves of chromite. The magnitude of reserves in these countries varies widely. South Africa, with 74% of the world reserves, heads the list, followed by Rhodesia (22%), India ranks fourth (0.3%), the third country being Turkey (Table 2.1). Other countries which have known chromite deposits include the Philippines, the USSR, Cuba, Japan and Yugoslavia. With more exploratory activities discovery of new chromite belts cannot be ruled out.

Table 2.1 : World Chromite Reserves and Share of Major Countries—1969

Country	Reserves (Million tonnes)	% of total World Reserves
World Total	2,703	100.0
South Africa	2,000	74.0
Rhodesia	600	22.2
Turkey	10	0.4
India	8	0.3
Other countries	85	3.1

Source : (1) Mining Journal, London.
(2) Statistical Summary of the Mineral Industry, London.
(3) Mineral Trade Notes, US Bureau of Mines.

2.3 Production of chromite shows a gradual increase during the five years ending 1968. As against a total output of 4,240 thousand tonnes in 1965 production touched the level of 5,275 thousand tonnes in 1968, an increase of 24.4% (Table 2.2).

World Production

2.4 USSR is the largest producer in the world, contributing 30% of the world production in 1968. South Africa, which is the leading country in chromite reserves, comes next to the USSR in production (22%). India, by contributing 3.9% of world production, occupies the sixth place. Among the major producers of the world Turkey and Rhodesia show a declining trend in production whereas there has been wide fluctuation in the case of the Philippines. Increase in production in the USSR and South Africa is not so spectacular as it is in India. During the five year period 1964-68 India's production increased by 489%.

Countrywise Production

2.5 The world demand for chromite in 1969 was estimated as 5,292 thousand tonnes. Five countries of the world viz. the USA, Japan, the USSR, West Germany and France accounted for 57% of total world demand. The USA alone accounted for 23% of the total demand. India's requirement of chromite during 1969 was about 80 thousand tonnes (1.5%).

World Demand

2.6 The major exporting countries of the world are the USSR, South Africa, the Phillippines, Turkey and India. It may be mentioned that the first three exporters, viz. the USSR, South Africa and the Philippines, are also the three largest producers of chromite. A little less than one-third of the export comes out of the USSR (Table 2.3). Out of the total export of 3450 thousand tonnes the first five countries take a dominant share (82%).

World Exports

Table 2.2 : World Production of Chromite 1964—68

(In thousand tonnes)

Country	Production					% Share
	1964	1965	1966	1967	1968*	1968
World Total	4,240	4,870	4,952	4,972	5,275	100.0
USSR	1,300	1,420	1,450	1,518	1,587	30.1
South Africa	850	942	1,060	1,157	1,162	22.0
Turkey	413	567	635	574	540	10.3
Philippines	468	554	560	452	467	3.8
Rhodesia	448	566	454	N.A.	N.A.	—
India	35	60	78	114	206	3.9
Other countries	726	761	715	1,157	1,313	24.9

N.A.—Not Available *Provisional

Source : (1) IBM—Indian Minerals year book, 1966.

(2) Statistical year book, United Nations.

Table 2.3 : World Export of Chromite (1968)

Country	Export (Thousand tonnes)	% Share
World Total	3,450	100.0
USSR	1,048	30.4
South Africa	867	25.1
Philippines	412	11.9
Turkey	387	11.2
India	109	3.2
Other countries	627	18.2

Source : Indian Bureau of Mines.

World Imports

2.7 Among the major consumers of chromite, only the USSR is self-sufficient. Others, such as the USA, Japan, West Germany, France, Italy and the UK depend almost entirely on imports. The USA is the largest importer of the world taking 31.6% of the ore traded (Table 2.5), followed by Japan (18.4%), West Germany (10.5%), France (7.6%), Italy (4.7%) and the UK (4.6%).

Table 2.4 : World Import of Chromite (1968)

Country	Import (Thousand tonnes)	% Share
World Total	3,450	100.0
USA	1,089	31.6
Japan	636	18.4
West Germany	361	10.5
France	263	7.6
Italy	162	4.7
UK	160	4.6
Other countries	778	22.6

Source : Indian Bureau of Mines.

2.8 It is interesting to analyse the imports made by the major consumers according to their sources of supply (in 1969). South Africa is the single major supplier of chromite to the USA, Japan and West Germany (Table 2.5)

followed by the USSR. Imports of the UK are almost equally contributed by South Africa and Philippines. More than 95% of India's chromite export goes to Japan.

Table 2.5 : World Imports by Sources of Supply (1969)

(In thousand tonnes)

Exporting Country	Importing Country							
	USA	Japan	West Germany	France	Italy	UK	Others	Total
World Total	1,089	636	361	263	163	160	778	3,450
USSR	375	168	119	97	54	—	235	1,048
South Africa	390	179	157	18	12	77	33	867
Philippines	147	148	—	—	5	81	31	412
Turkey	103	—	34	26	10	—	214	387
India	—	104	—	—	—	—	5	109
Others	74	37	51	122	81	2	260	627

Source : Indian Bureau of Mines.

3. Geology and Reserves in India

3.1 Distribution of chromite ore is not so widespread as that of iron ore and manganese ore. The ore is found only in a few States. The reserves of chromite in India amount to about 8 MT, out of which 1.8 MT is proved reserve. Occurrences of this ore have certain peculiarities. It is reported to be available in ultrabasic host rocks such as pyroxenite, peridotite or serpentine except in Salem district in Tamil Nadu where it occurs in association with anorthosites. It occurs as veins, lenses or bands within the ultrabasic rocks. Major deposits are found in Orissa and Mysore. Deposits of lesser importance are also located in Bihar, Andhra Pradesh, Maharashtra and Tamil Nadu. These States show wide variation in their chromite deposits. **India's Resources**

3.2 Orissa ranks first so far as chromite reserve is concerned. With 5.1 MT she contributes 64% of the country's reserve. The three districts where chromite exists are Cuttack, Dhenkanal and Keonjhar. The ore occurs as schlieren bands, massive lenses, veins and stringers in sheared and altered ultrabasic rocks. Two types of ore are generally noticed viz., brown and grey. While the former is friable, the latter is hard and compact. Orissa is endowed with both metallurgical and refractory grades. The ore is of generally high grade, the average chromite content varying from 45% to 60% with a chrome to iron ratio ranging from 3 : 1 to 3.8 : 1. The important deposits are Nausahi **Orissa**

(2.5 MT) in Keonjhar district and areas adjoining Saruabil, Gurjang, Maruabil and Kaliapani (2.6 MT) in Cuttack district.

Mysore

3.3 Mysore comes next to Orissa and accounts for 21.2% of the total reserves. Bairapur area of Hassan district is the major chrome deposit in Mysore where almost the entire resource is found. Occurrences are also noticed in Mysore, Chickmagalur and Chitradurga districts. In Hassan district the ore occurs as disseminated grains and lenses in talc serpentine matrix. With a chrome to iron ratio of 2 : 1, the ores in Mysore fall below the metallurgical grade. The average chrome content varies from 46% to 48%.

Maharashtra

3.4 Maharashtra has a probable reserve of 0.6 MT of chromite which is traced in the districts of Bhandara and Ratnagiri. The reserves in Bhandara have been estimated to be about seven times the reserves of Ratnagiri. The ore has been associated with dunite and serpentine. Ores of Maharashtra are generally of refractory grade, the average chrome content varying from 34 to 52%.

Other States

3.5 Other states which share 0.6% of the country's reserves are Andhra Pradesh, Bihar and Tamil Nadu. In Andhra Pradesh sporadic deposits occur in Warangal and Krishna districts. In Bihar chromite, which occurs as segregations and veins in ultrabasic rocks, is found in the districts of Singhbhum and Bhagalpur. Important ore deposits in Tamil Nadu are noticed in Salem district. However, ores in these States are of less importance both in terms of quantity and quality.

Table 3.1 : Reserves of Chromite in India

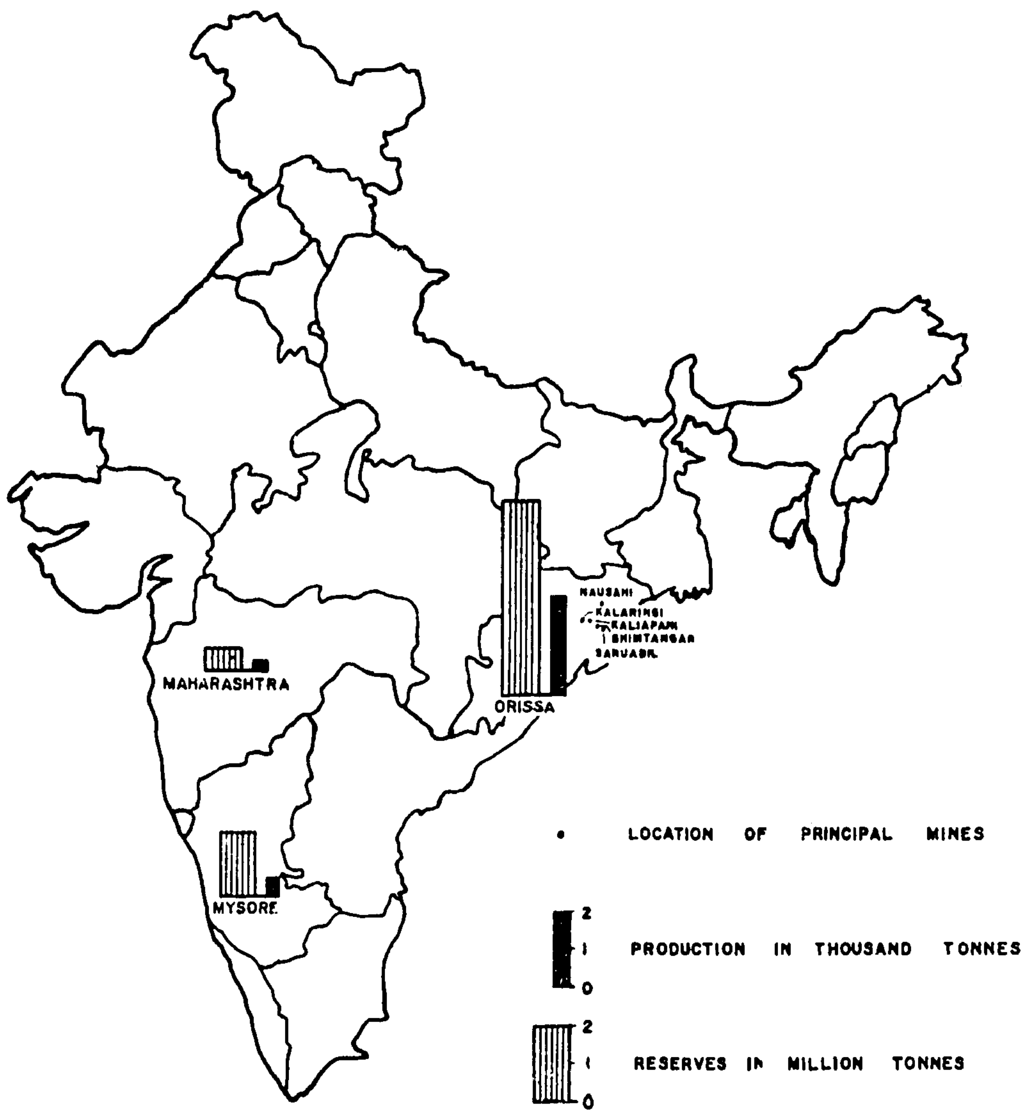
State	Reserves (Million tonnes)			% Share
	Proved	Probable	Total	
All India	1.9	6.1	8.0	100.0
Orissa	1.2	3.9	5.1	63.8
Mysore	0.7	1.0	1.7	21.2
Maharashtra	—	0.6	0.6	7.5
Others	—	0.6	0.6	7.5

Source : (1) Geological Survey of India
(2) Industrial Programmes for Fourth Plan, Maharashtra.

4. Structure of Chromite Mines in India

4.1 There were only 12 mines by the end of 1970. Out of these three belonged to the public sector. The nature of ownership is either proprietorship or limited company. The Orissa Mining Corporation, which came into existence in

LOCATION OF PRINCIPAL CHROMITE MINES, RESERVES & PRODUCTION BY STATES, 1970



1956, entered into chromite mining in 1963 at Manulabhanj. But the mine was closed in early 1964 because ore of economic grade could not be located. It was only in the latter part of 1966 and in 1967 that the corporation started two big mines viz. Kaliapani and Kalaringi in the chromite belt of the Sukinda valley. Some of the important mines in the private sector are Nausahi (Orissa) of Serajuddin & Co., Saruabil (Orissa) of Misrilal Jain and Bhimtangar (Orissa) of the Tata Iron and Steel Company. Out of these, the Saruabil mine of Misrilal Jain is the biggest.

Nature of Ownership

4.2 Chromite mining in India is of more recent origin than mining of rion ore or manganese ore. The method of mining is also different because of the peculiarities noticed in the occurrence of ore. As already mentioned the ore generally occurs as veins, lenses or bands within ultrabasic rocks. The lenses and veins occur in an extremely faulted zone and, due to highly disturbed nature of the ground, mining becomes difficult and costly. India's chromite mines are generally open cast. Except for one mine in Hassan district of Mysore State, all other chromite mines in India are open cast. The depth of the mine varies from 5 metres to 40 metres. During the rainy season working in pits poses a problem because of water-logging, resulting in suspension of work in lower benches till the water is drained out by pumps. Mechanisation is not prevalent in chromite mines. Most of the mines have only compressors or pump sets as mechanical equipment. In the chromite belt of the Sukinda valley utilisation of compressors for drilling is also not common owing to the softness of the o

Type of Working

4.3 Chromite mines tend to be small in India. In the majority of the cases the average daily employment is less than five hundred. Data available from the Director General of Mines Safety show that during 1968, 50% of the chromite mines had an average daily employment of 150 and below (Table 4.1). The only mine with an employment of over 250 was the Kaliapani mine of the Orissa Mining Corporation. A visit to some of the major mines in the course of the survey showed that the situation has not changed much except for the Kaliapani mine where the present daily employment is about 700. It was also observed that except for the mines of the Orissa Mining Corporation, labour is employed directly. In all the mines of the corporation contract labour is in vogue. Productivity of labour in chromite mines varies from 0.15 to 0.45 tonnes per man-shift. Uncertainty in the occurrence of the ore, and the high ratio of rejects and waste to saleable grade ore, are the main reasons for such low productivity.

Employment

4.4 Accidents in chromite mines are few and far between. This is because of less mechanisation. Reports from the Director General of Mines Safety do not mention any serious or fatal accidents. During the study team's visit to the mines this has been confirmed. There had been a few accidents causing minor injuries ; no serious/fatal accident had occurred in these mines.

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Table 4.1 : Distribution of Chromite Mines by Employment Groups (1968)

Employment Groups	No. of Mines	Percentage
Up to 50	—	—
51 to 150	4	50.0
151 to 250	2	25.0
251 to 500	1	12.5
501 to 800	—	—
Total	8	100.0

Source : The Director General of Mines Safety (DGMS)—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

5. Production Trend and Grade Structure

Concentration of Mines in Orissa

5.1 Only four States account for all the twelve mines of the country. Even among these four States the number of mines varies widely. Orissa has two-thirds of the total number of mines (Table 5.1). A few mines working in Bihar in earlier years had been closed down prior to 1966 and in the years 1966-69 Bihar had no chromite mine. But in 1970 two mines have come into existence and this has placed Bihar next to Orissa. There is one mine in Mysore and one in Maharashtra.

Table 5.1 : Number of Chromite Mines Operating during 1966-70

State	1966	1967	1968	1969	1970	
					No.	%
Orissa	4	5	6	6	8	66.7
Bihar	—	—	—	—	2	16.7
Mysore	1	1	1	2	1	8.3
Maharashtra	1	1	1	1	1	8.3
Andhra Pradesh	1	—	—	—	—	—
All India	7	7	8	9	12	100.0

Source : (1) DGMS — Statistics of Mines in India, Vol. II, Non-Coal.

(2) IBM — Mineral Statistics, 1969 and 1970.

5.2 The present production of chromite in India is 271,000 tonnes as against 227,000 tonnes in 1969. An analysis of production data for the last ten years shows wide fluctuations. The total production fell from 106.9 thousand tonnes in 1960 (Table 5.2). In the two succeeding years it showed a marked increase, which was again followed by a decline in 1964. The main reason for such fluctuations is not far to seek. Prior to 1965 the internal requirement for chromite having been low, demand from abroad was the guiding factor in determining production. A look into India's chromite exports during this period shows almost a similar trend. Export fell from 81.6 thousand tonnes in 1959 to 41.2 thousand tonnes in 1960. In the next year the volume of ore exported remained constant. But in the subsequent two years it declined to 16.5 and 10.3 thousand tonnes, respectively. It is only in 1965 that export of chromite rallied and since then export has increased rapidly. **Fluctuation in Production**

5.3 Orissa dominates the country's chromite production by mining more than 96% of ore produced. Mysore, which comes next to Orissa, accounts for about 2% of production. Maharashtra's contribution to total production is less than 1%. As regards quality of ore, Orissa produces higher grades as compared to the other States.

Ores in Orissa have been considered suitable for both metallurgical and refractory purposes. The mines visited in the course of the survey were all producing ore of high grade (above 45%).

Table 5.2 : Production of Chromite during 1961-70 All India and Major States

(Quantity in thousand tonnes)

Year	All India		Orissa		Mysore		Maharashtra	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%
1961	48.8	100.0	39.1	80.0	3.2	6.5	1.3	2.5
1962	66.6	100.0	51.2	75.8	7.8	11.7	0.6	0.9
1963	69.0	100.0	51.3	74.3	7.6	11.1	3.0	4.4
1964	34.9	100.0	29.2	83.7	2.8	8.1	0.7	2.1
1965	59.7	100.0	56.8	95.2	1.7	2.8	1.0	1.6
1966	77.8	100.0	76.2	97.3	—	—	1.6	2.0
1967	113.9	100.0	113.6	99.7	—	—	0.3	0.3
1968	205.7	100.0	201.6	98.0	3.5	1.7	0.6	0.3
1969	226.6	100.0	219.2	97.3	5.0	2.2	2.4	0.2
1970	270.9	100.0	261.0	96.4	4.8	1.7	2.5	0.9

Source : IBM—Mineral Statistics of India, January 1971.

Public vs. Private Sector

5.5 Prior to 1966, the entire production was coming from mines in the private sector. But in 1966, for the first time, contribution to production came from the public sector. The Orissa Mining Corporation, a public sector undertaking, made a modest beginning by contributing a little over 4% of the total production (Table 5.3). In the next year production of the two mines of the corporation contributed 43% of the total production. Since then there has been wide fluctuations in production and OMC's share in total production has shown a net decline. The reason for this decrease again is a decrease in export. In 1969-70 the corporation's export increased from 59.5 thousand tonnes in 1968-69 to 90.2 thousand tonnes. But in 1970-71 quantity exported was as low as 35.9 thousand tonnes.

Table 5.3 : Production of Chromite During 1966-70—Public Sector and Private Sector

(Quantity in thousand tonnes)

Year	All India		Public Sector		Private Sector	
	Qty.	%	Qty.	%	Qty.	%
1966	77.8	100.0	4.4	5.6	73.4	94.4
1967	113.9	100.0	49.1	43.1	64.8	56.9
1968	205.7	100.0	79.3	38.5	126.4	61.5
1969	226.6	100.0	103.9	45.8	122.7	54.2
1970	270.9	100.0	73.0	26.9	197.9	73.1

Source : 1. IBM—Mineral Statistics of India, January 1971.
2. ORG Mineral Survey.

6. Processing of Chromite

Necessity for Processing

6.1 Rational utilisation of chromite has been considered as a vital task in recent years in order to conserve this scarce resource. There is already a move towards stopping export of chromite so as to avoid the crisis likely to arise from rising internal demand. This not only calls for conservation of existing reserves and extension of area exploited, but also use of existing ores in the most economical way.

Uses of Chromite

6.2 Chromite is used in three major fields, viz. metallurgical, refractory and chemical industries. In the metallurgical sphere it is used as an element to impart high tensile strength, acid and rust resistance and wear resistance. Chromite ore for metallurgical purposes requires chrome content of a minimum of 48% and a minimum chrome to iron ratio of 2.8 : 1. For refractory and chemical purposes the required chrome content is 38—48% and 48—50% respectively. It has been observed that use of chromite is not done in a rational way

taking into account the above specifications. Sometimes even the metallurgical grade is used for refractory purposes, thereby reducing the available high grade ore to that extent. Two things are needed to make effective use of chromite, viz. upgrading the low-grade ore and making the friable high grade ore suitable for metallurgical purposes.

6.3 It has been estimated that a limited quantity of the country's chrome ore reserve is lumpy and high grade and suitable for metallurgical industries. There is a substantial quantity of friable ore of high grade with chrome to iron ratio of 3:1 which is not suitable for metallurgical purposes simply because of its powdery nature. Such ores can be agglomerated so as to make them suitable for metallurgical use without any initial upgrading. The various types of agglomeration are sintering, briquetting and pelletising (including granulation). In recent years pelletisation has become very popular in advanced countries like the USA, Germany, Japan, the USSR and Australia. In India iron ore is agglomerated in the form of sinters and pellets. But no such development has taken place in chromite. The Regional Research Laboratory, Government of India at Bhubaneswar has carried out pelletising studies on chromite on a limited scale and has achieved encouraging results. As per this laboratory's estimation, the capital investment required for a chromite pelletisation plant with 100,000 tonne capacity is about Rs. 30 million. The cost of production, which includes costs of raw materials, labour, supervision, maintenance, depreciation, interest, insurance and overhead, has been estimated to be Rs. 200 to 300 per tonne of pellets.

Agglomeration of Friable Ore

6.4 The laboratory has also taken up a study on preparation of pellets by a cold process. It is reported that if this process is established it will not be necessary to harden the pellets by thermal treatment. This would help in overcoming a number of problems concerning drying, pre-heating and firing by conventional means. This would also bring down the cost to a great extent.

6.5 Presently a lot of ore is thrown out which are ferruginous and to a lesser extent siliceous and hence unsuitable for any industry. There are possibilities of upgrading these ores with the help of mineral dressing techniques such as size classification, gravity separation, floatation, pyro and hydro-metallurgical methods, reduction roasting followed by magnetic separation etc. Such upgraded ores, after agglomeration, can be suitably used for various purposes. Attempts are being made to determine the economics of these methods.

Upgrading of Low Grade Ore

6.6 Adoption of these methods, which require heavy investment, is not free from obstacles under the prevailing conditions. The uncertainty in the occurrence of the ore and its short supply tend to dissuade mineowners from venturing large investment. It has been reported that even some of the important deposits now being mined are not expected to last for many years. Therefore, a prerequisite to establishment of beneficiation plants is detailed and systematic exploration

in the existing leases. The prospects will be enhanced considerably if incentives, such as financing and tax concessions, are made available for detailed exploratory activities.

7. Cost and Price Structure

Cost and Price Structure

7.1 Mining cost in chromite mines is generally high because of the peculiarities in the occurrence of ore. There are reported cases where working in certain pits has had to be suspended because of non-availability of suitable grade. Cost of mining depends upon the extent of overburden, method of mining, richness of deposits and the volume of production. In this section analysis has been made of mining cost and f.o.r. and f.o.b.t. costs.

7.2 On the basis of data collected from the survey, mining cost has been calculated for mines in the public sector and in the private sector. It is interesting to see the closeness of these two groups in terms of mining cost (Table 7.1).

Table 7.1 : Mining Cost of Selected Mines

Cost in Rs. per tonne

Year	Public Sector		Private Sector	
	Cost	% to f.o.r. cost	Cost	% to f.o.r. cost
1966-67	14	35.0	15	41.6
1967-68	19	46.3	22	46.0
1968-69	13	29.0	14	35.0

Source ; ORG Mineral Survey.

7.3 As already mentioned, f.o.r. cost is constituted of mining cost, other indirect costs of production and cost incurred on transport, including loading. It may be noticed that mining cost as a percentage of f.o.r. cost remains lower in the public sector mines than in the private sector. Transport cost including loading charges remaining the same for the two groups of mines, rest of the cost is accounted for by larger indirect cost in the public sector undertaking.

7.4 Most of the contracts for sale of chromite for internal consumption are on f.o.r. basis. The f.o.r. cost varies from Rs. 40/- to Rs. 45/- in the public sector and Rs. 36/- to Rs. 48/- in the private sector (Table 7.2). As against this the f.o.r. price ranges from Rs. 151/- to Rs. 177/- in the public sector and Rs. 165/- to Rs. 170/- in the private sector. The difference between f.o.r. cost and price realisation in chromite is very high. This is because the price of chromite is governed by the export price which is on the high side. However, in recent years f.o.r. cost and price have been moving in opposite directions.

Table 7.2 : F.O.R. Cost and Price of Selected Mines

Rs. per tonne

Year	Public Sector		Private Sector	
	f.o.r. cost	f.o.r. price	f.o.r. cost	f.o.r. price
1966-67	40	151	36	170
1967-68	41	177	48	166
1968-69	45	161	45	165

Source : ORG Mineral Survey.

7.5 The price of chromite is determined not on the basis of chromite content alone but also on the percentage of silica in it. Between two types ore with the same chrome content, a better price will be fetched by one with less silica. Generally three prices prevail depending upon the three grades determined on the basis of silica content. The price varies from Rs. 94/- per tonne for chromite with high silica content to Rs. 170/- per tonne with low silica.

Price Determination

7.6 The analysis of cost and price structure will not be complete without a reference to the f.o.b.t. cost and price. The elements which constitute f.o.b.t. cost include f.o.r. cost, freight charges including unloading, port charges, export duty, agency commission and analysis charges. The f.o.b.t. cost of some of the mines visited ranges from Rs. 77/- to Rs. 82/- per tonne. As against this the realisation is, on an average Rs. 178/-, per tonne.

F. o. b. t. Cost and Realisation

8. Marketing and Transportation

8.1 Demand for chrome ore is both internal as well as external. Chromite is required within the country for manufacturing ferro-chrome, refractory bricks and bichromates. These three uses require three different grades. The internal requirement for chromite was 33.6 thousand tonnes in 1966, out of which more than 76% went to the refractory industry. But with the establishment of ferro-chrome plants, the demand for the metallurgical grade of chromite has substantially increased. The present requirement of chromite of all grades is estimated to be more than 80 thousand tonnes, an increase of about 135% since 1966. Out of this about 45% is required for refractories and 40% by ferro-chrome plants.

Internal Consumption

8.2 It has been observed that chromite produced only in Orissa is suitable for metallurgical purposes. The two ferro-chrome plants that exist now in the country get their chromite from Orissa. These two units have a licenced annual capacity of 10,000 tonnes each. As already mentioned, chromite fines, even if

they satisfy the required chemical composition, have been unacceptable to ferro-chrome plants because of their size. Manufacture of chrome pellets is yet to start in the country.

Export

8.3 Export of chromite from India shows a rising trend in recent years (Table 8.1). In 1965-66 the exported quantity of chromite was as low as 25 thousand tonnes. But in 1966-67 it jumped to 70 thousand tonnes, an increase of 180%. In the next year there was a slight fall in India's export. This is due to absence of export to Australia for that year, which in the earlier years had accounted for about 10% of the country's total chromite exports. Importers of India's chromite during 1968-69 were Japan, Australia and Thailand. India's exports rose from 67 thousand tonnes in 1967-68 to 110 thousand tonnes in 1968-69. There was a further increase in 1969-70. Presently, the main importer of chromite is Japan which absorbs almost the entire export of India.

Table 8.1: Export of Chromite (Grade-wise) during 1965-66 to 1969-70

(Quantity in thousand tonnes)

Grade	1965-66		1966-67		1967-68		1968-69		1969-70	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%	Qty.	%
High	6.4	25.2	18.0	25.8	0.9	1.6	73.8	67.0	111.7	78.0
Medium	—	—	19.3	27.6	14.0	20.6	19.2	17.4	18.6	13.0
Others	19.0	74.8	32.5	46.5	52.1	77.8	17.1	16.6	12.9	9.0
Total	25.4	100.0	69.8	100.0	67.0	100.0	110.1	100.0	143.2	100.0

Source : Monthly Statistics of Foreign Trade, Government of India.

8.4 Prior to 1968-69 grades other than high or medium had the largest share in chromite export. But since 1968-69 export of high grade ore has increased rapidly. Presently more than three-fourths of India's export consists of high grade ore. This has created an alarming situation in the country and it is feared that with the existing trend India may face a crisis in the near future. Voices have been raised from many corners to stop further export of chromite. Presently, with the exception of ore satisfying *all* the following specifications, chrome ore is allowed to be exported :

(a) Cr_2O_3 content is not less than 38%

(b) FeO content is not more than 22%

(c) SiO_2 content is not more than 10%

(d) Al_2O_3 plus Cr_2O_3 content is not more than 54% and

(e) in physical condition, the ore is not friable.

8.5 While there are restrictions to trading directly with the buyer in iron ore or manganese ore, no such imposition has been made in the case of chromite. There is no binding on the chromite mineowners to market their produce through MMTC. Some of the important places of the country where chromite is marketed are Jajpur Road and Belpahar in Orissa, Garividi in Andhra Pradesh and Chaibasa in Bihar. Except for Jajpur Road where ore comes by road the modes of transport used are both road and rail. The main loading stations in India for despatch of chromite are Jajpur Road, Bhadrak and Pauni Road in South Eastern Railway and Tiptur in Southern Railway. Out of all these loading points Jajpur Road in South Eastern Railway (Orissa) takes the lead by handling more than 75% of total despatches. This is because Jajpur Road is the railhead nearest to all the major mines located in the Sukinda Valley. Bhadrak which caters to another major chromite belt in Keonjhar district of Orissa handles 14% of the total despatches.

Loading Points

8.6 As regards exports, almost the entire quantity is being exported from the mines in Orissa through Paradip port. Ores from Bhadrak and Jaipur Road are sent by rail to Nergundi in South Eastern Railway, and from there they are transported to Paradip by road over a distance of 110 kilometres.

8.7 One of the major problems that the industry has been facing is lack of a good road from the mine head to the nearest district road/highway. The road condition being very bad and the railhead being away from mine, mineowners have to bear a substantial amount towards transportation cost. In all the mines visited in the Sukinda Valley the transport cost is as much as mining cost, if not more, and it constitutes in all cases as high as 50% of f.o.r. cost. These mines which account for more than 75% of total despatch have no pucca approach road and particularly during rainy season movement of ore is hindered by bad road conditions. A proposal is under consideration to construct a pucca road (40 kms) between Tomka and Goda. This road will connect the mines with the express highway near Tomka on one side and a district road on the other. Since this project will involve substantial investment, the State might find it difficult to secure the finances needed for its early completion.

8.8 There is another problem which the mineowners in Orissa have been facing and this relates to the procedure laid down by the Government for verification of stocks before ore is transported from the mine. Under the present procedure, no ore can be transported from the mine unless the mine manager gets a permit from the concerned Mining Officer, who represents the State Government for that purpose. The Mining Officer, before issuing such permit, has to wait for a verification report from the Mining Inspector. It is reported that the Government has formulated this procedure to determine royalty. But it is noticed that even if the mineowner declares that all the ores produced by him are high grade and is prepared to pay the maximum royalty, he is unable to circumvent the procedure. This creates unnecessary delay in the movement of ore.

9. Future Prospects

9.1 Demand for chromite is likely to get a boost in coming years because of the enhancement of production of ferro-chrome, refractories and bichromates. The Sub-group IV of Planning Group of Minerals has estimated the internal requirements of chromite by the end of the Fourth Plan (1973-74) and the Fifth Plan (1978-79). As per the estimates of the Group, demand for chromite is expected to go up from the present level of 80 thousand tonnes to 100 thousand tonnes in 1973-74 and 143 thousand tonnes in 1978-79 (Table 9.1). The anticipated shares of the consuming industries for these two years are ferro-chrome 44% and 38%, refractories 36% and 32% and bichromates 20% and 30% respectively.

Table 9.1 : Projected Demand for Chromite in India

(In thousand tonnes)

Industry	Projected Production		Consumption norm per tonne of production	Projected demand for chromite	
	1973-74	1978-79		1973-74	1978-79
Ferro-chrome	20	25	2.2	44	55
Refractories	60	80	0.6	36	45
Bichromates	12	25	1.7	20	43
Total	92	130	—	100	143

Source : Report of the Sub-Group IV, Planning Group of Minerals.

Surplus in Future

9.2 The group has recommended stopping export of chromite by 1973-74 so as to forestall too rapid depletion of reserves. The conclusions of the Group are based on the present limited known reserves of chromite and production in 1967 (113.9 thousand tonnes). This production level had been expected to remain constant in the years after 1967. But chromite production has more than doubled in 1970 as compared to 1967 from 113.9 thousand tonnes to 270.9 thousand tonnes. This means that even if the present level of chromite production is maintained, the surplus of chromite over internal demand will be 171 thousand tonnes in 1973-74 and 128 thousand tonnes in 1978-79. The question that arises here is whether the mineowners should be asked to curtail production. In this connection it may be worthwhile to analyse the future prospects for world export.

Recent Trend in World Export

9.3 The recent trend in world export shows that after the trade ban put on Rhodesia in 1966, the world has been facing a scarcity of high grade metallurgical chromite ore. This has put the USSR in a commanding position to dictate the export price. The present export price of the USSR is higher by

about $ 10 per tonne than the price prior to 1968. It is expected that if the present embargo against Rhodesia continues, the price may go upto $ 56 per tonne. The demand for chromite has been increasing fast. Countries which are likely to face scarcity in metallurgical grade ore are the USA, the UK, and Japan.

Future Strategy

9,4 This puts India in a sound position, In order to take the advantage the future strategy should be planned in three dimensions. Firstly, detailed exploration needs to be carried out without further delay so as to improve the present position of known and proved reserves. Secondly, the feasibility of agglomerating fines and friable ores satisfying the specifications of metallurgical industries should be worked out. Such agglomerated ore can be used for internal consumption thereby saving lumpy ores for export. Thirdly, steps should be taken to stop using lumpy metallurgical grade ore for manufacturing refractaries and to devise ways to use sub-grade materials. Recent research studies show that for the refractory industry chrome ore with barely 30% chrome content and 30 to 40% silica can be used, The Tata Iron and Steel Company uses chromite with 20% chrome content and 25% sillica for making chrome magnesite bricks. Attempts should be made to convert other units also to such conservational practice.

CHAPTER III—MANGANESE ORE

1. Introduction

Export Oriented Industry

1.1 India ranks third in the world in the production of manganese ore. During 1968, India's production was 1.6 million tonnes (MT) compared to 2.1 MT of South Africa and 8.2 MT of the USSR. In India, manganese ore occupies fourth position among minerals, after coal, crude petroleum and iron ore. In terms of value, manganese ore constitutes only 1.7% of the total mineral production of the country. Prior to 1960, the manganese ore industry in India was almost entirely dependent on exports. But subsequently, with the setting up of the steel plants in the public sector and the establishment of the ferro-manganese plants, the indigenous consumption of manganese ore has increased. The industry is still export oriented. During 1969-70, total exports were about 1.5 MT. Export of manganese ore constitutes about 8% of mineral exports and about 0.8% of total exports from India.

2. Brief Review of World Manganese Ore Industry

2.1 The total world reserves of manganese ore (+35% Mn) are estimated to be about 1,200 MT. About 50% of the reserves are in the USSR. Other major deposits are in Gabon, India, Brazil and the Republic of South Africa (Table 2.1).

Table 2.1 : World Reserves of Manganese Ore, 1969

Country	Estimated Reserves	
	Million tonnes	%
World Total	1,205.0	100.0
USSR	625.0	51.9
Gabon	200·0	16.6
India √1	180.0	14.9
South Africa	100.0	8.3
Brazil	100.0	8.3

√1 Total inferred reserves

Source : (1) Mining Journal, London.
(2) Statistical Summary of the Mineral Industry, London.

Slow Growth of World Manganese Industry

2.2 Against the estimated reserves of about 1,200 MT, total world production during 1968 was about 18 MT. During the five year period 1964-68, world production of manganese ore increased by about 2.5 MT, a growth of about 14% (Table 2.2).

Table 2.2 : World Production of Manganese Ore, 1964-68.

Country	Average Grade (% Mn content)	Production (Million tonnes)					% Share during 1968
		1964	1965	1966	1967	1968	
World Total		15.8	17.6	18.4	18.8	18.3	100.0
USSR	N.A.	7.1	7.8	7.7	8.2	8.2	44.8
South Africa	+30	1.3	1.6	2.0	2.3	2.1	11.5
India	35—40	1.4	1.6	1.7	1.6	1.6	8.7
Gabon	50—52	0.9	1.3	1.3	1.2	1.2	6.5
Brazil	38—50	1.4	1.2	1.2	1.2	1.1	6.1

N.A. - Not available

Source : (1) Mineral Trade Notes, US Bureau of Mines.
(2) Statistical Summary of the Mineral Industry, London.

Gabon mines the best manganese ore in the world, the average grade of ore produced being 50—52% Mn. Compared to this, the average grade produced by India is quite low (35—40% Mn). In terms of total tonnage, the USSR accounted for 45% of the total world production during 1968. Shares of all the other major countries, the Republic of South Africa, India, Gabon and Brazil, range between 6 and 12%. Compatible with the slow rate of growth of the world production, production of all the major countries except Brazil also increased slowly during the five year period 1964-68. Production of Brazil declined from 1.4 MT in 1964 to 1.1 MT in 1968.

2.3 Total world demand for manganese ore is estimated to be of the order of 18 MT. This means that total world production is just enough to meet the demand. Analysis of world export and import pattern indicates that about 50% of the world requirement is met from imports and the rest from indigenous supplies. This will be evident from the fact that out of total world requirement of about 18 MT, total exports during 1968 were about 8.6 MT (Table 2.3). **World Demand**

2.4 USSR is not only the largest producer of manganese ore in the world, but also one of the largest consumers and as a result, out of a total production of 8.2 MT only 1.2 MT were exported during 1968. By volume of total exports, South Africa ranks first in the world followed closely by India, the USSR, Brazil and Gabon. During 1964-68, exports of South Africa increased by 0.7 MT in the total world increase of 1.2 MT. **World Export**

Table 2.3 : World Export of Manganese Ore, 1964-68

(In million tonnes)

Country	1964	1965	1966	1967	1968	% Share during 1968
World Total	7.4	7.8	8.3	8.1	8.6	100.0
South Africa	1.0	1.2	1.5	1.5	1.7	19.8
India*	1.3	1.3	1.2	1.0	1.3	15.1
USSR	1.0	1.0	1.2	1.3	1.2	13.9
Brazil	0.8	1.1	1.0	0.7	1.1	12.8
Gabon	0.9	1.1	1.2	1.1	0.9	10.5

*Data relate to the financial year April-March.

Source : (1) Statistical Summary of the Mineral Industry, London.
(2) Commodity Trade Statistics, UN.

World Import

2.5 The major importers of manganese ore are the major steel manufacturers of the world. The two largest importers are the USA and Japan. Import by Japan has been increasing steadily. During 1964-68, total imports by Japan increased by 200%, from 0.6 MT to 1.8 MT. Besides the USA and Japan, other major importers of manganese ore are West Germany, France and Norway. World import, total and by major countries, is shown in Table 2 4.

Table 2.4 : World Import of Manganese Ore, 1964-68

(In million tonnes)

Country	1964	1965	1966	1967	1968	% Share during 1968
World Total	7.3	7.8	8.3	8.1	8.6	100.0
USA	1.9	2.3	2.3	2.1	2.0	23.2
Japan	0.6	1.1	1.5	1.5	1.8	20.9
West Germany	0.8	0.7	0.9	0.8	1.0	11.6
France	0.8	0.9	0.8	0.7	0.9	10.5
Norway	0.4	0.5	0.5	0.5	0.7	8.1

Souice : (1) Statistical Summary of the Mineral Industry, London.
(2) Commodity Trade Statistics, UN.

3. Manganese Ore Reserves in India

3.1 The important deposits of India are located in Madhya Pradesh, Maharashtra, Orissa, Mysore, Gujarat, Andhra Pradesh, Rajasthan and Bihar. Of these, the manganese belt of Nagpur—Bhandara—Balaghat districts of Madhya Pradesh and Maharashtra is the most important from the point of view of quality and also the extent of reserves and actual production. Next in importance is the Keonjhar—Bonai manganese belt of Orissa. In the Keonjhar—Bonai belt of Orissa and in Shimoga—Chitaldurg—Tumkur—Sandur—North Kanara districts of Mysore, manganese and iron ores occur in the same fields. Ores generally suitable for the manufacture of ferro-manganese are found in the Nagpur—Chindwara—Balaghat—Bhandara belt of Madhya Pradesh and Maharashtra and also in the Shimoga—Chitaldurg—Tumkur, the Bellary and the North Kanara belts of Mysore.

Madhya Pradesh & Maharashtra

3.2 The manganese ore deposits of Chindwara, Nagpur, Bhandara and Balaghat districts of Madhya Pradesh and Maharashtra occur in an arcuate belt 130 miles long and 16 miles wide. There are more than 200 individual deposits within the belt, of which 20 are major producing deposits. The reserves of run of mine ore containing 30 to 40% manganese are estimated at 12 MT per 100 ft. down dip extension in the 17 major deposits along the belt. Both measured and indicated reserves in these deposits are estimated at 20 MT. Inferred reserves are of the order of 142 MT, of which 75 MT are probably of metallurgical grade with 48% manganese content. Characteristic features of these ores are their low iron content and lumpy nature.

Orissa

3.3 The bulk of the reserves in Orissa is in the Keonjhar—Bonai manganese field. Most of these deposits are shallow and do not extend below the water table ; recovery of high grade ore is low compared to the Madhya Pradesh—Maharashtra belt. Only 30% of the ores have a manganese content of 40% and above. The ores are generally low in phosphorous, but high in iron. A few deposits consist of dioxide ore of chemical and battery grades with 97% MnO_2 content. Important deposits are at Nalda-Jamda, Belkundi, Barbil, Bhadrassi, Bonai, Koira, Joda, Kalimati, Dhubhna and other places in Keonjhar and at Malda, Kalmang, Patmunda and Bhutra in Bonai. Total estimated reserves are of the order of 4.5 MT of which 30% of the ore has manganese content of 40% and above. Probable reserves are of the order of 21 MT.

Mysore

3.4 The manganese ore deposits of Sandur in Bellary district, in Mysore State, are distributed over a distance of 20 miles extending from Ramandrug in the north-west to Kammadheruvu in the south-east. Ramandrug deposits are practically exhausted except for some very low grade left in the workings. Active mining is now being done in the Kammadheruvu—Kanavehalli region south of the main Sandur—Kerdling road.

The average grade of ore varies from 32-35% manganese, although local concentrations of high grade ore averaging 50-52% manganese are not uncommon. The ore reserves are of the order of 0.8 MT.

Manganese ore deposits of North Kanara and Belgaum occur in five different belts in an area of 170 sq. miles in Supapetha and Khanapur taluks. Deposits in Supapetha contain sizeable reserves. On a preliminary examination, the reserves of the entire area are estimated at 10 MT, half of which are of workable grade. The iron content of the ores is generally high, but silica and phosphorus are remarkably low. The manganese ore deposits of Shimoga, Chitaldurg and Tumkur districts in Mysore are distributed in eight main areas : (1) Shankaragudda, (2) Kumsi, (3) Shikarpur, (4) Chunnagiri, (5) Shiddanhalli, (6) Chikanayakanahalli, (7) Kare Karichi and (8) Kondi. The ores are generally of low grade containing 35-45% manganese with low percentage of phosphorus. There serves are of the order of one MT.

Andhra Pradesh

3.5 Manganese ore deposits in Srikakulam district, Andhra Pradesh occur along four main NW-SE trending belts : (1) a southern belt comprising the quarries of Kodur-Davada and Chinna Bantupalle, (2) a south central belt covering the quarries of Garbham, Vedullavalasa, Avagudem, Chipurpalle and Perapi, (3) a north central belt including the quarries of Aitemvalasa, Gadabavalasa, Batna, Karlam and Nimmalavalasa and (4) a northern belt consisting of the quarries of Gotundi, Garuja and Joda. The ore is generally low grade containing on an average 36% manganese, 14% iron, 12% silica and 0.25% phosphorus. The ore from Kodur—Garbham—Aitemvalasa area is generally low in phosphorus and high in iron, whereas that in Ramabhadrapuram area is high in phosphorus and low in iron. The reserves are estimated at 0.51 MT over the entire belt.

Gujarat

3.6 Manganese ore deposits in Panch Mahals and Baroda districts, Gujarat, occur at four places near (1) Shivrajpur, (2) Bamankua, (3) Talaori and (4) Pani. The Shivrajpur zone extends in a E-W direction from Bapatia to Shivrajpur mines for a length of 5,000 ft. and extends for another 2 miles in a northern direction from Shivrajpur. The reserves of manganese ore with an average manganese content of 46% are estimated at 1.73 MT. The Bamankua zone is 3,500 feet long. The reserves of ore with 43-45% manganese content are estimated at 0.3 MT. The Pani zone is about 2 miles long with estimated reserves of about 0.5 MT. Besides these, major deposits of manganese ore also occur at Gandhra, Val, Bhabar, Anas, Ambala and Jothward.

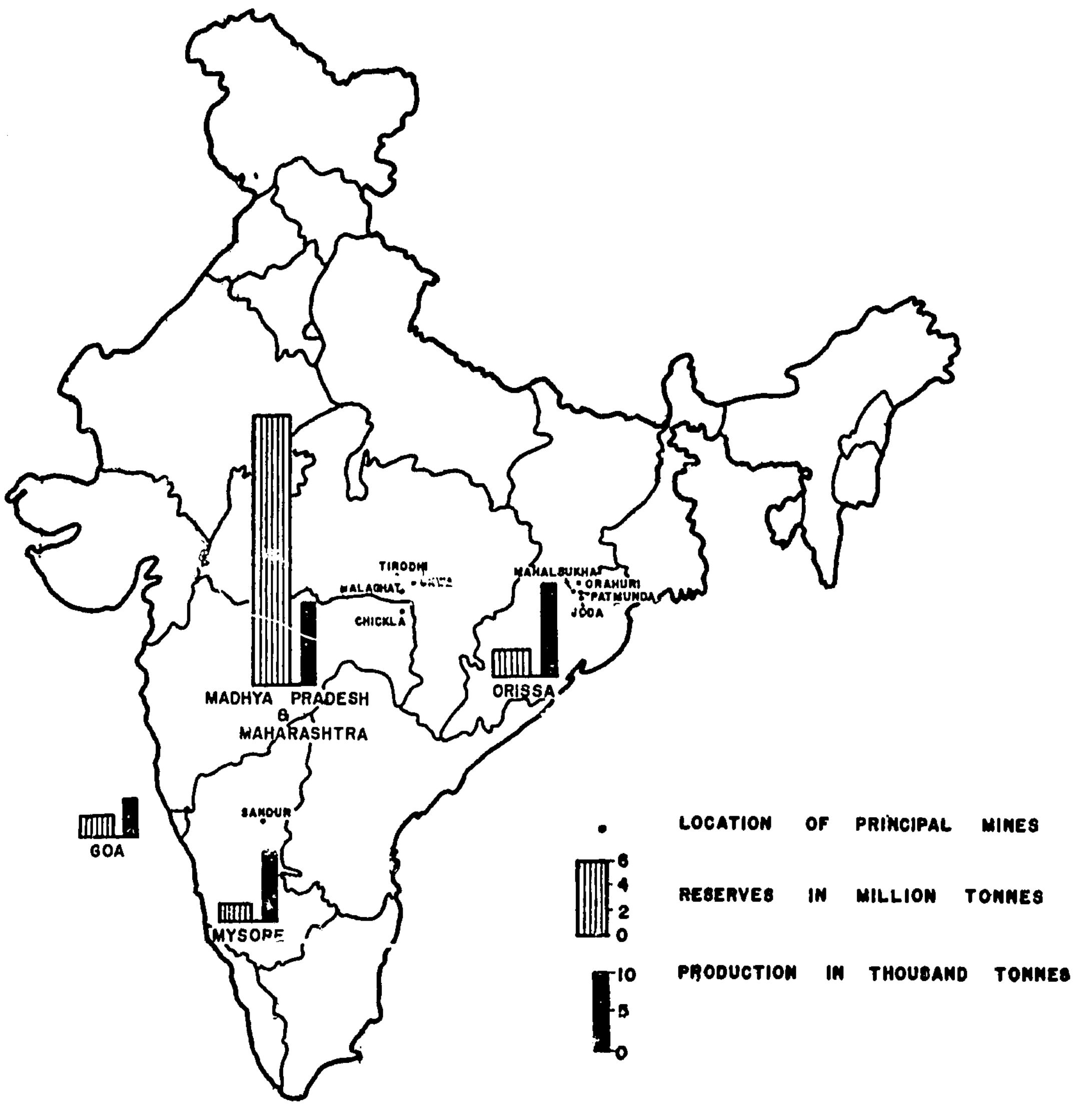
Rajasthan

3.7 In Rajashthan, manganese ore deposits occur mostly in Banswara and Udaipur districts and a few in Jaipur district. The ore is generally of low grade ranging from about 28-48% manganese content. The probable reserves are estimated at 2 MT.

Goa

3.8 Important deposits of manganese ore in Goa are concentrated in Sanguem. Quepem and Canacona taluks. Of these, the Rivona—Colomba deposits and

LOCATION OF PRINCIPAL MANGANESE ORE MINES, RESERVES & PRODUCTION BY STATES, 1970



those near Verlem—Salginen are by far the most important. The reserves in the Goa deposits are estimated at 6 MT manganese ore and 10 MT of ferruginous manganese ore.

Estimated reserves of manganese ore of all grades, all India and Statewise, are summarised in the table below.

Table 3.1 : Reserves of Manganese Ore in India Estimated by GSI, 1970

State	Estimated Reserves	Approx. Grade in % Mn
All India	59.5	
MP—Maharashtra	20.3	High Mn
Orissa	21.6	40
Mysore	12.6	40—50
Gujarat	2.5	31—55
Rajasthan	2.0	25—48
Andhra Pradesh	0.5	36

Source : Interim Report of the Working Group on Manganese Industry, Department of Mines and Metals, Government of India, October, 1970.

4. Structure of the Manganese Ore Mining Industry in India

4.1 Although manganese ore mining in India is an old industry dating as far back as the twenties, the method of mining has not materially progressed from the earlier ways of quarrying. The majority of the mines are opencast workings. Blasting and breaking of the ore and waste rock are usually done by hand drilling, the use of air compressors and jackhammers being confined to a few mechanised mines (both opencast and underground).

Predominantly Private Sector Venture

4.2 Manganese ore mining in India is predominantly a private sector venture. Assessed in terms of total production, the contribution of the public sector was only 22% in 1969. The number of mines operated in the public sector was 20 compared to 426 mines operating in the country. The largest unit in India, however, is a public sector unit, namely Manganese Ore India Ltd. (MOIL). MOIL accounted for 18% of all India production and about 80% of production of the public sector. MOIL is at present operating 12 mines of which 8 are mechanised. Of the other public sector mines, only one is semi-mechanised and the rest non-mechanised (including one captive mine of Hindustan Steel Ltd.).

The private sector consists of a vast majority of non-mechanised mines worked by small operators. There are a few mines which are semi-mechanised (including the captive mines of TISCO). Even the largest mine of Sandur

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Manganese and Iron Ores Ltd., the largest unit in the private sector, is a semi-mechanised mine. Sandur ranks next to MOIL in production. During 1969, total production of the company was 205 thousand tonnes and constituted about 14% of production of the private sector.

Common forms of ownership in the private sector mines is proprietorship and partnership. There are a few private limited companies and a still smaller number of public limited companies which include the Tata Iron and Steel Company and Sandur Manganese and Iron Ores Ltd.

Employment

4.3 That manganese mining in India is dominated by a large number of small mines will also be evident from average daily employment (Table 4.1) and production of the individual mines.

Table 4.1 : Average Daily Employment in the Manganese Mines in India, 1968

Employment Groups	No. of Mines
Up to 50	164
51 to 150	68
151 to 250	14
251 to 400	6
401 to 500	5
501 to 800	10
801 to 1200	5
1201 to 1600	2
Above 1600	3

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

It would be noticed that out of 277 mines operating in 1968, average daily employment in as many as 164 mines (about 60%) did not exceed 50 and there are 232 mines (about 85%) with average daily employment not exceed 150. There are, however, mines (three in number) as big as to employ more than 1600 persons daily.

Production

4.4 Annual production of about 50% of the mines range up to 500 tonnes and production of about 85% of the mines does not exceed 5,000 tonnes. Major part of the production, however, comes from few mechanised and semi-mechanised mines. The biggest mine in India is producing about 200,000 tonnes annually.

Mine Safety

4.5 Human risk is associated with all mining activities. Manganese ore is no exception to this. But compared to coal mines, incidence of deaths and accidents is much less in manganese ore mines. Comparative rates of death, serious

injury and accidents, fatal and serious, in coal, iron ore and manganese mines in India are shown below (Table 4.2).

Table 4.2 : Accidents and Death in coal, iron ore and manganese mines in India, 1968

	Rates per 1000 employed persons		
	Coal	Iron Ore	Manganese Ore
Death	0.53	0.29	0.16
Serious injury	4.68	1.42	1.52
Accident Fatal	0.47	0.27	0.16
Serious	4.50	1.38	1.92

Source : Indian Labour Statistics, Labour Bureau, 1970.

For human safety, hats and boots are used in the manganese ore mines. In underground mines, safety lamps are also used.

5. Production Trend and Grade Structure

5.1 Assessed in terms of total production, the manganese ore industry in India has not shown any perceptible growth during the last ten years. The number of working mines during 1966-70, however, showed a fluctuating trend with an overall increase of about 10% during this period. The number of working mines in Madhya Pradesh declined drastically—from 81 in 1966 to 28 in 1970, accompanied by a decline in production. The decline in Madhya Pradesh's production was matched by increase in production of Orissa, Mysore and Andhra Pradesh to maintain the constancy of all India production. Increased production in Mysore came mostly from the new mines (20) which were opened during this period. Number of working mines in India and major States during 1966-70 are shown in Table 5.1.

Table 5.1 : Number of Manganese Ore Mines Operating in India and Major States, 1966-70

Year	Number of Operating Mines				
	All India	Madhya Pradesh	Maharashtra	Orissa	Mysore
1966	295	81	53	42	56
1967	308	73	56	46	58
1968	277	54	48	44	52
1969	426	58	59	54	77
1970	328	28	33	37	76

Source : (1) DGMS—Statistics of Mines in India, Vol. II, Non-Coal.
(2) IBM— Mineral Statistics of India, 1971.

Relative shares of Public and Private Sectors

5.2 It has been mentioned in Section 4.2 that participation of the public sector in manganese ore production in India was only to the extent of 22% in 1969. Trend in production of the public and private sectors during 1966-70 (Table 5.2) reveals that the share of the public sector has ranged between 22 and 27%.

Table 5.2 : Relative Shares of Public and Private Sectors in Manganese Ore Production in India, 1966-70

(Quantity in thousand tonnes)

Year	All India	Public Sector		Private Sector	
		Qty.	% share	Qty.	% share
1966	1,710.0	393.3	23.0	1,316.7	77.0
1967	1,617.0	448.9	27.8	1,168.1	72.2
1968	1,610.0	334.1	20.7	1,275.9	79.3
1969	1,485.0	323.6	21.8	1,161.4	78.2
1970	1,651.0	405.7	24.6	1,245.3	75.4

Source : (1) IBM— Mineral Statistics of India, January, 1971,
(2) ORG Mineral Survey.

No Perceptible Growth in Production

5.3 As mentioned above, in terms of production, there has been no perceptible growth in the manganese ore industry in India during the last ten years. During 1961-70, total annual production was fluctuating between 1.5 to 1.7 MT (Table 5.3).

Table 5.3 : Production of Manganese Ore During 1961-70—All India and Major States

(Quantity in thousand tonnes)

Year	All India	Maharashtra	Madhya Pradesh	Mysore	Orissa	Andhra Pradesh
1961	1,234	178	227	274	393	72
1962	1,234	167	232	283	422	60
1963	1,116	146	235	242	377	69
1964	1,305	224	276	239	402	127
1965	1,636	317	302	287	459	134
1966	1,621	340	330	280	510	111
1967	1,574	329	297	260	516	144
1968	1,556	291	258	331	497	145
1969	1,289	157	183	313	461	147
1970	1,651	214	210	362	487	148

Source : IBM—Mineral Statistics of India, January, 1971.

Production of the major States showed almost constant trends except for Orissa, Mysore and Andhra Pradesh. In Orissa production of all grades increased from 0.4 MT in 1961 to 0.5 MT in 1970 and in Mysore it increased from 0.3 MT to 0.4 MT and in Andhra Pradesh from 0.04 to 0.15 MT.

Grade Structure of Production

5.4 It would be noticed that by tonnage of ore produced, Orissa ranks first among the producing regions. By unit value, Madhya Pradesh and Maharashtra occupy the first two positions, because ore produced in Madhya Pradesh and Maharashtra are of predominantly high commercial grade (above 45% Mn) while that produced in Orissa is predominantly low grade (below 38% Mn). Ore produced in Mysore is medium (38—45% Mn) and low grade (almost equally divided between the two). Of the total production in India, about 40% is high grade ore. about 20% is medium grade and the rest 40% is low grade. Grade structure of manganese ore production in India and in the major producing regions, Madhya Pradesh, Maharashtra, Mysore and Orissa during 1965-69 are shown below (Table 5.4).

Table 5.4 : Gradewise Production of Manganese Ore, All India and Major States 1965-69

(Production in thousand tonnes)

Year	Total		High Grade 1/ (Over 48% + ½ of 44-48% Mn)		Medium Grade (38—43% Mn + ½ of of 44-48% Mn)		Low Grade (Below 38% Mn)	
	Production	% Share	Production	% Share	Production	% Share	Production	% Share
All India								
1965	1,647.0	100.0	480.2	29.2	491.6	29.8	675.2	41.0
1966	1,710.0	100.0	486.7	28.5	505.4	29.5	717.9	42.0
1967	1,617.0	100.0	435.8	27.0	509.7	31.5	671.5	41.5
1968	1,610.0	100.0	384.9	24.0	532.1	33.0	693.0	43.0
1969	1,485.0	100.0	305.1	20.5	368.2	24.8	811.7	54.7
Madhya Pradesh								
1965	302.5	100.0	206.1	68.1	72.2	23.9	24.2	8.0
1966	330.1	100.0	206.6	62.6	97.8	29.6	25.7	7.8
1967	297.1	100.0	185.3	62.4	83.2	28.0	28.6	9.6
1968	260.7	100.0	155.5	59.8	72.6	27.8	32.6	12.5
1969	183.0	100.0	141.0	76.8	24.3	13.2	18.3	10.0
Maharashtra								
1965	317.0	100.0	193.3	61.0	96.3	30.4	27.4	8.6
1966	340.3	100.0	201.1	59.1	94.8	27.9	44.4	13.0
1967	329.5	100.0	175.2	53.2	96.5	29.3	57.8	17.5
1968	289.9	100.0	150.7	52.0	100.5	34.7	38.7	13.3
1969	163.0	100.0	93.5	57.3	36.7	22.6	32.8	20.1

Mysore								
1965	287.2	100.0	10.5	3.6	140.7	49.0	136.0	47.4
1966	280.9	100.0	8.5	3.0	141.9	50.5	130.5	46.5
1967	260.0	100.0	3.4	1.3	155.9	60.0	100.7	38.7
1968	327.3	100.0	6.7	2.0	201.1	61.4	119.5	36.6
1969	313.2	100.0	8.6	2.7	176.0	56.2	128.6	41.1
Orissa								
1965	459.2	100.0	70.3	15.3	138.5	30.2	250.4	54.5
1966	510.7	100.0	68.4	13.4	136.7	26.8	305.6	59.8
1967	516.6	100.0	70.3	13.6	157.9	30.6	288.4	55.8
1968	495.6	100.0	70.9	14.3	149.7	30.2	275.0	55.5
1969	458.5	100.0	63.6	13.8	122.9	26.8	272.0	59.4

1/ includes dioxide grade in case of Maharashtra and Orissa

Source : Interim Report of the Working Group on Manganese Industry, Department of Mines and Metals, Government of India.

6. Processing of Ore : Beneficiation

Need for Beneficiation of Low Grade Ores

6.1 Because of the fact that as much as 40% of production of manganese ore in India is of low grade, the need arises for upgrading the ore through beneficiation to improve marketability and unit value realisation. Prior to 1960, there was hardly any market for low grade manganese ore either for internal consumption or for exports. This resulted in rejection of low grade ores in large quantities while mining high grade manganese ore. For every tonne of high grade ore desptched from the mine, about an equal quantity of low grade ore was being thrown away. The possibility of utilisation of low grade ore through beneficiation had attracted the attention of the Government of India and various national laboratories. Following the recommendations of the committee headed by Mr. J.D. Kapadia in 1957, the Indian Bureau of Mines and the National Metallurgical Laboratory have carried out extensive research on beneficiation of low grade ores on the samples collected from various manganese ore mines in different parts of the country. The ore dressing section of the Indian Bureau of Mines has completed a number of projects on consultancy basis from the mineowners. The Regional Research Laboratories in Hyderabad and Bhubaneshwar are also carrying out research on beneficiation of the ores of respective regions.

6.2 In spite of the increasing realisation about the need for beneficiation on a large scale, only two plants are reported to have been set up so far ; one is the heavy media separation plant at the Dongri-Buzurg mine of the Central Provinces Manganese Ore Co. Ltd., set up in 1954 and the other is the beneficiation plant of M/s Sreeram Durgaprasad at Garividi mines. The latter plant is reported to be facing certain difficu'lties in achieving the reduction of the phosphorus content of the ores. The Manganese Ore India Ltd. is contemplating a beneficiation plant at the Balaghat Mine.

The beneficiation practices generally followed in India, at present, comprise of hand sorting and picking, manual jigging (some cases mechanical) and washing. Estimated costs of the different processes of beneficiation are shown below.

Table 6.1 : Costs of Manual Beneficiation of Manganese Ore

	Cost (Rs./Tonne of Concentrate)
1. Breaking and sorting	5.00
2. Jigging	5.00
3. Washing	2.50

6.3 The overall situation with regard to the utilisation of low grade ores has changed during the last ten years and the possibility of upgrading the low grade ores has to be viewed in the light of these developments. With the setting up of the public sector steel plants, consumption of low grade ore (30-35% Mn) within the country has increased. The proposed steel plants at Vishakapatnam, Hospet and Salem are expected to increase the demand further. The export market for low grade ores also has developed to a large extent. Out of the total exports of about 1.2 MT during 1969-70, exports of ferruginous ores were as high as 0.7 MT.

Case for Beneficiation

In view of all this and because of the fact that beneficiation necessarily entails reduction both by weight and volume of the original material in the process, it is important that costs and benefits of beneficiation are carefully worked out before beneficiation is undertaken on a commercial scale.

7. Cost and Price Structure

7.1 The cost of mining of manganese ore varies rather widely, depending on the richness of the deposit, depth of the mine, nature of working (opencast or underground), ratio of ore to waste, the methods of mining (mechanised or non-mechanised), and the scale of operation (the level of production). The inter-mine variations in costs will be evident from Table 7.1. The table shows variations in unit mining cost of a cross-section of opencast and underground, mechanised, semi-mechanised and non-mechanised, mines in different regions and of different production levels during 1969-70. Because of the wide variations in unit costs, it will not be realistic to estimate the average cost of mining.

7.2 The predominant component in the total mining cost is labour. Because most of the manganese mines are opencast workings and mostly non-mechanised (at best semi-mechanised), mining becomes a highly labour-intensive process. On the basis of minimum wages in Orissa, the wages for male labour work out to about

Rs. 25 out of the total mining cost of Rs. 42 per tonne of ore. This also indicates that movements in minimum wages is likely to have direct impact on the movement of total mining cost. Against this background, it will be interesting to see the trend in unit mining cost in a cross-section of big and small, underground and opencast, mines during 1965-66 to 1969-70 (Table 7.2).

Table 7.1 : Unit Mining Costs in Selected Manganese Ore Mines in India of Different Production Levels, 1969-70

Sr. No.	Production (thousand tonnes)	Mining Cost Rs./tonne
1	1.0	18.93
2	2.2	32.77
3	3.2	25.34
4	4.9	12.75
5	6.2	15.66
6	7.3	9.06
7	10.1	13.45
8	13.8	21.89
9	19.0	11.18
10	24.4	21.27
11	64.5	32.32
12	74.8	14.63

Source : ORG Mineral Survey.

Table 7.2 : Mining Cost of selected Manganese Ore Mines in India, 1965-66 to 1969-70

(cost in Rs. per tonne)

Sr. No.	1965-66	1966-67	1967-68	1968-69	1969-70
1	24.78	18.62	15.42	17.55	17.59
2	11.26	13.30	22.15	29.01	36.13
3	N.A.	20.48	15.04	16.06	18.79
4	N.A.	27.86	20.95	29.02	25.00
5	23.12	19.70	21.77	21.77	27.33
6	11.50	19.50	16.19	18.88	21.27
7	17.16	14.28	14.83	13.01	14.63
8	27.95	26.68	33.21	31.08	32.32
9	N.A.	10.50	10.79	13.19	12.75
10	N.A.	21.87	20.88	18.86	21.89
11	9.98	7.41	9.12	7.52	9.06
12	22.75	21.50	22.75	23.25	22.74

N.A.—Not available.

Source : ORG Mineral Survey.

In spite of increasing labour costs and prices of other major mining inputs, the table above shows a mixed trend in unit mining cost. This points to the fact that it will be wrong to assess the increase in costs only in terms of increase in costs of inputs. The changes in important related factors like the richness of deposits, depth levels, method of operation, nature of working etc.—which influence the cost of mining operation, at any point of time, need also to be taken into consideration.

7.3 To consider the overall profitability of the industry, unit cost has to be studied in relation to the unit value realisation over the years. For this purpose, f.o.r. selling cost is worked out. The major components included in f.o.r. cost are, in addition to the mining cost, royalties, administrative overheads and transport cost from the pithead to the railway station. F.o.r. cost may be directly compared with f.o.r. selling price to see the profitability of the industry.

Stationary Prices of Manganese Ore

7.4 Analysis of the prices realised by some of the major mines reveals that domestic sales prices (f.o.r.) of manganese ore did not register any increase during 1966-67 to 1969-70. Some of the prices, in fact, showed a small decline. Price of HSL grade (30-35% Mn), the most commonly sold low grade ore, was maintained around Rs. 25 per tonne. In the case of most of the surveyed mines, the prices of high grade (46—48% Mn) ore declined during this period. Selling prices (f.o.r.) gradewise, and f.o.r. cost of one of the major mines in Orissa during 1966-67 to 1969-70 are shown below (Table 7.3). It would be seen from the table that f.o.r. cost increased by about 25% during this period.

Table 7.3 : F.O.R. Cost and Selling Price, Gradewise, of One of the Major Mines in Orissa, 1966-67 to 1969-70.

Grade	F.o.r. Selling Price Rs./Tonne			
	1966-67	1967-68	1968-69	1969-70
50—52%	210.31	219.06	257.62	238.82
48—50%	148.71	175.00	162.68	166.73
46—48%	120.63	123.30	108.96	114.51
38—40%	46.38	46.90	44.89	41.72
30—35% (HSL Grade)	25.66	26.53	25.68	25.08
F.o.r. cost	37.82	40.15	45.09	46.57

Source : ORG Mineral Survey.

Downward Trend in Export Realisation

7.5 Vis-a-vis the trend in domestic realisation, it will be noticed (Table 7.4) that unit value realisation on exports of all grades of ores showed a downward trend during 1965-66 to 1969-70.

Table 7.4: Unit Value Realisation on Export of Manganese Ore from India, 1965-66 to 1969-70.

Year	High Grade	Medium Grade	Low Grade (Ferruginous Ore)
1965-66	200.08	172.55	76.44
1966-67	190.16	142.66	64.57
1967-68	187.40	130.80	68.96
1968-69	178.15	125.70	73.20
1969-70	163.59	114.02	70.12

Source : ORG Mineral Survey.

Average export prices of high and medium grades showed considerable decline during the five-year period 1965-66 to 1969-70, while the unit export realisation on ferruginous ores had shown least fluctuations.

8. Marketing and Transportation

8.1 As has been mentioned in 'Introduction' the manganese ore industry in India is export oriented. The domestic consumption consists primarily of:

(i) low grade ores, normally 30—35% Mn, consumed by the steel plants and

(ii) high grade ores and oriental mixtures (+46% Mn) consumed by the ferro-manganese plants.

Total domestic consumption of all grades of manganese ore during 1969 was about 0.8 million tonnes.

8.2 Export of manganese ore, except that of MOIL, is canalised through the Government-owned Minerals and Metals Trading Corporation (MMTC). MOIL is allowed to export directly. Exports of MOIL do not exceed 20% of the total exports. So, about 80% of exports of manganese ore from India is canalised through the MMTC.

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Table 8.1 : Export of Manganese Ore from India, Gradewise

1965-66 to 1969-70

Quantity in thousand tonnes
Value in million rupees

Year	Total		High Grade		Medium Grade		Low Grade*	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1965-66	1331.1	168.9	234.0	46.8	397.5	68.6	699.6	53.5
1966-67	1184.1	142.9	251.9	47.9	446.0	63.6	486.2	31.4
1967-68	1045.9	110.6	178.8	33.5	279.4	36.6	587.7	40.5
1968-69	1312.7	134.0	158.7	28.3	404.9	50.9	749.1	54.8
1969-70	1158.2	110.1	166.3	27.2	304.9	34.8	687.0	48.2

*Ferruginous Ores.

Source : Monthly Statistics of Foreign Trade, Government of India.

It would be noticed that in terms of total tonnage, exports of medium grade and ferruginous ores have not shown any significant change. The fall in total value of exports of medium grade ore is very evident. This is due to the decline in the unit value realisation. Exports of high grade ores have declined by both tonnage and value. This is partly due to the decline in production of high grade ores and also because of increasing diversion of these ores to domestic ferro-manganese units.

Transportation Most Pertinent Problem

8.3 The most pertinent problem concerning the mineowners in both internal marketing and exports is associated with transportation. The major problems of transportation relate to :

i) cost of transportation from mines to railway stations,
ii) availability of wagons at the loading stations,
iii) incidence of railway freight.

The cost of transportation from the mine to the railway station is dependent on two factors—first, the length of the approach road and second, the condition of the roads. In a majority of the cases, the mineowners are inconvenienced either by both or one of these factors and as a result the transportation cost becomes high. There are cases where the transport cost is as high as 25% of the f.o.r. cost. In all these cases, to increase the competitiveness of Indian manganese ore in the foreign markets, the cost needs to be reduced either by improving the condition of the existing roads or by constructing new roads. The table below identifies some important road links in different States which need to be improved to facilitate ore movement.

Table 8.2 : Road Links between Mines and Railway Stations in Different States and their Lengths

State		Road link	Length (kms)
Madhya Pradesh-Maharashtra	1.	Meghanagar-Kajlidongri	13
	2.	Ambajhari-Tirodhi	16
	3.	Khapa-Ramtek & Saoner	24
Bihar-Orissa	1.	Navagarh-Raghudih	22
	2.	Joda-Patmunda	21
	3.	Joda-Nayagarh	36
	4.	Barsua-Sarikunda	10
Mysore	1.	Dandeli-Patoli Joida	24
	2.	Joida-Diggi Sanvordem	55
Andhra Pradesh	1.	Garbham-Garividi	15
	2.	Perari-Garividi	14

Source : ORG Mineral Survey.

Non-availability of railway wagons is reported to be a chronic problem. This has resulted in accumulation of large stocks at the railway sidings.

8.4 Railway freight absorbs a considerable part of the f.o.b.t. realisation on manganese ore. Table 8.3 shows railway freight as percentage of f.o.b.t. realisation of different grades of ores exported from different ports in India.

Incidence of Railway Freight

Table 8.3 : Railway Freight as Percentage of f.o.b.t. Prices of Manganese Ores, 1968-69

Region	High Grade	Medium Grade	Low Grade	Port
Andhra Pradesh	—	—	11	Vishakhapatnam
Mysore				
i) Sandur	—	23	30	Marmagao
ii) N. Kanara	—	11	15	-do-
Orissa	16	23	31	Calcutta
Madhya Pradesh and Maharashtra	23	23	—	Vishakhapatnam

Source : Interim Report of the Working Group on Manganese Industry, Department of Mines and Metals, Government of India.

It would be noticed from the table that in some cases the percentage of railway freight to f.o.b.t. price is as high as 31. It also may be mentioned here that while f.o.b.t. sales realisations on high and medium grade ores decreased by Rs. 25 and Rs. 16 per tonne respectively between 1967-68 and 1969-70, during the same period railway freight increased by from Rs. 2 to Rs. 15 per tonne.

9. Economics of Export of Ferro-Manganese Versus Manganese Ore

9.1 With increase in production of ferro-manganese in India, export of this semi-processed product is steadily increasing. Between 1966-67 and 1969-70, export of ferro-manganese increased from about 10,000 tonnes to about 115,000 tonnes. Export, by quantity and value, during this period is shown below.

Table 9.1 : Export of Ferro-Manganese from India, 1966-67 to 1969-70

Quantity in thousand tonnes
Value in million rupees

Year	Exports	
	Quantity	Value
1966-67	10.3	8.1
1967-68	29.3	24.2
1968-69	70.3	39.2
1969-70	115.4	84.4

Source : Monthly Statistics of Foreign Trade, Government of India.

High Foreign Exchange Earning on Ferro-manganese

9.2 Most of the production of high grade manganese ore in India is, at present, exported in the form of ferro-manganese. There is also an apparent case for export as ferro-manganese rather than directly as ore, because unit foreign exchange earned on the former is more compared to the latter. The average ratio of manganese ore to ferro-manganese is 2.7 : 1. It would be evident from the table below that export realisation on one tonne of ferro-manganese is more than that on 2.7 tonnes of high grade ore.

Table 9.2 : Export Realisation on One tonne of Ferro-Manganese and 2.7 tonnes of High Grade Ore, 1966-67 to 1969-70

Year	Ferro-manganese (Rs./tonne)	High Grade Manganese Ore (Rs./2.7 tonnes)
1966-67	795.01	513.43
1967-68	826.96	505.98
1968-69	558.45	481.01
1969-70	731.26	441.69

Source : Monthly Statistics of Foreign Trade, Government of India.

Ferro-Manganese Export versus Ore Export

9.3 In comparing the economics of export of ferro-manganese with that of manganese ore, if foreign exchange earning is the only consideration, the import component of other inputs needed for making ferro-manganese should be taken into consideration. The domestic component must also be considered in a more comprehensive economic analysis. In addition to the economics, two features of marketing should also be given consideration. Firstly, the export of high grade ore generally enables the exporter to obtain an associated contract for export of medium and low grade ores. Therefore, banning the export of high grade ore could make export of low grade ore very difficult. Secondly, the domestic ferro-maganese units have not shown much interest in entering into long-term contracts for the ores, perhaps due to uncertainty in the demand for their products in foreign markets. Therefore the mineowner would be faced with the problem of scheduling his operations while uncertain about the demand. Even such a large operation as MOIL has experienced accumulation of stocks due to fluctuations in domestic demand.

10. Future Prospects

The Government of India Working Group on Manganese, in its interim report (November 1970), has estimated both internal consumption and export of manganese ore for 1973-74. The demand for medium and low grade ores by the steel plants in India by 1973-74 is estimated to be 750 thousand tonnes. Out

of this, about 150 thousand tonnes are estimated to be supplied from the captive mines of the steel plants. The annual internal consumption of high grade ores (+46% Mn) by the ferro-manganese units by 1973-74 is estimated to be 480 thousand tonnes. Total exports by 1973-74, on the basis of anticipated world demand, is estimated at 145 thousand tonnes. Estimated internal consumption and exports, gradewise, during 1973-74, are shown below.

Estimated Future Demand

Table 10.1 : Estimated Internal Consumption and Export of Manganese Ore, 1973-74

(In thousand tonnes)

		1973-74
Total		2,676
Export		1,440
High grade	350	
Medium grade	410	
Low grade	690	
Internal consumption		1,236
High grade	483	
Medium grade	102	
Low grade	651	

10.2 Against the estimated annual production of about 2.6 MT of manganese ore of all grades by 1973-74, proved reserves are only of the order of 12 MT. Total measured and indicated reserves are about 60 MT.

This points to the need for immediate and extensive proving operations. Simultaneously, the objective should also be to establish adequate reserves of required grades of ores in the different geographical regions. The proved reserves are, at present, confined to Madhya Pradesh—Maharashtra only. In fact, it is only in Madhya Pradesh and Maharashtra that extensive geological mapping has been done and detailed exploration has been undertaken to a certain extent. In Orissa, Mysore and Goa, detailed surface mapping and regional assessment of ores are to be made before detailed proving operations are undertaken. Some work has already been initiated by the Geological Survey of India in parts of Orissa and Mysore.

Need for Extensive Exploration

10.3 The mineowners, on their part, are not seriously concerned about systematic and detailed exploration of the reserves in their lease areas. With the exception of a few major units (including the captive mines), it may be said generally that

the manganese ore industry in India is not working on an organised basis. Working of the majority of the mines is characterised by lack of systematic exploration, planned working and programmes for future development. An example may be taken of disposal of waste and overburden. In the majority of mines, waste and overburden are disposed of near the working pits. There have been cases where the overburden had had to be shifted from the original dumping place in order to allow exploration of ores there. The reason, however, why the overburden is not disposed of at safe distance within the lease area, is the high transportation cost. Disposal of waste near the working pits not only blocks the ore body below the overburden but also often proves dangerous to the working of the mine. A number of accidents, including a few fatal ones, have resulted from unplanned disposal of the waste.

Unorganised Nature of the Majority of Units

The major reasons generally put forward by the mineowners for lack of present and future planning are firstly, granting of leases for short periods (20 years) and secondly, difficulties associated with renewal of leases. Cases are reported where even the first renewal is delayed by 3 to 5 years. This problem has received a new dimension in recent years with increasing participation of the public sector in the mining industry. The private mineowners complain that wherever the public sector, particularly, the State Governmnnt, is interested, they experience difficulty in renewal of leases. The third major reason pointed out by the mineowners is dependence on offtake by the MMTC for exports. Because the MMTC does not enter into any long-term contract with the mineowners, production in each year is dependent on offtake by the MMTC during the same year. This infuses an element of uncertainty in mining and acts as a disincentive to long-term planning.

Profitability

10.4 The profitability of the industry has declined steadily over a period of several years. From data presented in Section 7, the behaviour during the period 1965-66 to 1669-70 may be examined. On the cost side, railway freight has increased steadily, and there has been increase in cost of transportation from the mine to the railhead. Other cost components have shown a mixed trend. On the revenue side, there has been a definite decline over the five-year period. The unit f.o.b.t. realisation fell during this period by the percentages given below :

High grade	20%
Medium grade	35%
Low grade (Ferruginous ore)	10%

One means of improving the profitability of the industry is by reduction or

removal of the export duties levied following the devaluation of the rupee in June, 1966. The duties are :

Dioxide grade	20% ad valorem
+48% Mn	Rs. 20.00 per tonne
10—48% Mn	Rs. 12.50 per tonne
Less than 10% Mn	Rs. 7.00 per tonne

Effect of Export Duties

The duties have not been revised since their first imposition though the production and market characteristics have changed considerably. Besides that they are considered too high, the rates appear to be poorly thought out. The same amount of duty on grades as widely varying as 10% Mn and 48% Mn, with a great difference in their f.o.b.t. prices, is discriminatory and works as a disincentive to export of low grade ore.

It is understood that abolition of the export duties is under consideration of the Government. This is a matter on which well-considered action at an early date is needed.

CHAPTER IV—BAUXITE

1. Introduction

Minor Role

1.1 India occupies the thirteenth place in world bauxite production. Bauxite plays a minor role in mineral production of India. In terms of value of minerals produced it stands next to gypsum and occupies the fourteenth place, contributing only 0.3% of the total. Among non-fuel minerals it contributes 1.4% of production. Bauxite export amounted to 0.2% of the value of total mineral export in 1969. The production of bauxite has been steadily rising but not the exports, which have been fluctuating. The export of bauxite has shown fluctuations generally between 6% to 10% of its production over the last five years. However, the importance of bauxite to the country's economy arises chiefly from its use in the domestic aluminium manufacturing industry, which has been growing rapidly and has good prospects.

2. Brief Review of World Bauxite Industry

World Reserves

2.1 The total world reserves of high grade bauxite are estimated to be about 6,005 MT. This is about 133 times the world demand in 1969. Therefore, bauxite would appear to be more scarce material than, for example, iron ore of which the known reserves exceed 1,000 times the demand in 1969. Bauxite is found in a number of countries of the world. But the countries each having more than 1% of the total world reserves number only 18.

Country-wise Variation

2.2 There is a wide range of variation in the reserve quantity of these countries. Australia alone accounts for one third (35%), followed by Guinea (10.2%) and Jamaica (10%). Thus about 55% of the total world reserves are located in these three countries. India, with 65 MT, 1.1% of the total reserves, ranks twelfth in the world (Table 2.1). The other countries following Jamaica, in order of reserves, are Hungary, Surinam, Ghana, Guyana, Yugoslavia, the USSR, Greece and France.

World Production

2.3 Bauxite production has maintained a steady increase during the five years ending 1969. As against a total output of 39.3 MT in 1965 production touched the level of 52.6 MT in 1969, an increase of 33.8% (Table 2.2).

Country-wise Production

2.4 Jamaica, which ranks third in reserves of bauxite, is the largest producer in the world, accounting for 19.6% of production in 1969. Although leading in reserve position, Australia with 15% occupies second place in production. Surinam, the USSR and Guyana follow Australia, contributing 11.9%, 9.7% and 8.2% respectively. India's share in the world production is only 2% and she occupies the thirteenth position. Of all the countries, Australia has taken the greatest stride in production, with an increase from 1.2 MT in 1965 to 7.9 MT in 1969. Whereas Jamaica and Surinam have had significant rise in production, France has maintained a constant output and Guyana, Guinea and the USA show fluctuations within narrow limits. The rest of the countries show steady progress

in raising their production. During the five year period India's production has gone up by 50%.

Table 2.1 : World Reserves and Share of Major Countries

Country	Reserves (In million tonnes)*	% Share
World Total	6,005	100.0
Australia	2,100	35.0
Guinea	610	10.2
Jamaica	600	10.0
Hungary	255	4.2
Surinam	250	4.2
Ghana	230	3.8
Guyana	150	2.5
Yugoslavia	130	2.2
USSR	102	1.7
Greece	85	1.4
France	70	1.2
India	65	1.1
USA	50	0.8

*High Grade only

Source : (1) Mining Journal, London.
(2) Monthly Bulletin of Statistics, UN.

Table 2.2 : World Production of Bauxite, 1965-69

Country	Production (In million tonnes)					% Share (1969)
	1965	1966	1967	1968	1969	
World Total	39.3	41.3	45.3	47.3	52.6	100.0
Jamaica	8.7	9.2	9.4	8.7	10.3	19.6
Australia	1.2	1.8	4.2	4.9	7.9	15.0
Surinam	4.4	5.6	5.5	5.7	6.2	11.9
USSR	4.7	4.8	5.1	5.1	5.1	9.7
Guyana	4.3	3.3	3.5	4.8	4.3	8.2
France	2.7	2.8	2.8	2.7	2.8	5.3
Guinea	1.9	1.6	1.6	2.1	2.1	4.0
Yugoslavia	1.6	1.9	2.1	2.1	2.1	4.0
USA	2.0	2.2	2.1	2.1	1.9	3.6
Hungary	1.5	1.4	1.6	1.9	1.9	3.6
Greece	1.3	1.4	1.7	1.8	1.9	3.6
Dominican Republic	0.9	0.8	1.1	1.0	1.2	2.1
India	0.7	0.8	0.8	1.0	1.1	2.0
Other countries	3.4	3.7	3.8	3.8	3.8	7.4

Source : (1) UN Stastical Year Book—1969.
(2) UN Monthly Bulletin of Statistics.

World Demand

2.5 The estimated world demand for bauxite in 1969 was of the order of 45 MT. The USA accounted for 14MT (31%), followed by the USSR with 6.4 MT (14%). Australia, France, Canada and Japan are the other important consumers, which together required nearly 12 MT (about 25%). India's requirement of bauxite during 1969 was about 0.85 MT.

World Export

2.6 The major exporting countries of the world are Jamaica, Surinam, Guyana, Yugoslavia, Australia and Greece. Jamaica with 33.5% and Surinam with 17.4%, together account for 51% of the total world bauxite trade of 23.6 MT in 1968 (Table 2.3). The other four countries' exports amount to another 29.2%. Jamaica and Surinam which headed the production during 1968 were also the leading exporters. Guyana which ranked fifth in production occupied third position in world exports. India accounts for only 0.4% of the total export, which is quite negligible.

World Imports

2.7 Among the major consumers of bauxite, the USA, Canada, Japan, West Germany, the UK and East Germany are almost entirely dependent upon imports. The USA is the largest importer of the world, taking 53.4% of the total world imports in 1968 (Table 2.4), followed by Canada (11.4%), Japan (10.2%) and West Germany (7.2%). The USSR meets only about 20% of her requirement from imports. Australia, India and Yugoslavia are fully self-sufficient in bauxite and also make exports. France meets a large part (90%) of her demand from within the country and hence has to depend only for about 10% on the imports.

Table 2.3 : World Export of Bauxite (1968)

Country	Export (Million tonnes)	% Share
World Total	23.6	100.0
Jamaica	7.9	33.5
Surinam	4.1	17.4
Guyana	2.3	9.7
Yugoslavia	1.9	8.1
Australia	1.5	6.3
India	0.1	0.4
Others	5.8	24.6

Source : Statistical Summary of the Mineral Industry, London.

2.8 It is interesting to analyse the imports made by the major consumers according to their sources of supply. The major suppliers to different countries are-Jamaica, Surinam and Dominican Republic to the USA ; Guyana and Surinam to Canada ; Australia, Indonesia and Greece to West Germany and Yugoslavia and Greece to the USSR. Italy imports bauxite from Yugoslavia, Indonesia and India, whereas the UK from Greece and India. About 85% of India's bauxite export was marketed to Italy and the UK in 1968.

Table 2.4 : World Imports of Bauxite (1968)

Country	Import (Million tonnes)	% Share
World Total	23.6	100.0
USA	12.6	53.4
Canada	2.7	11.4
Japan	2.4	10.2
West Germany	1.7	7.2
USSR	1.2	5.1
Others	3.0	12.7

Source : Statistical Summary of the Mineral Industry, London.

3. Geology and Reserves in India

3.1 The bauxite deposits of India are mostly associated with laterite, which occurs extensively as blankets or cappings either on the high plateaus and hill ranges of the Peninsular India or in certain low level laterite in the inland areas and coastal tracts of the country. Of the large areas of inland laterite, deposits of bauxite have been recorded only in the Katni area of Madhya Pradesh. Except in Saurashtra and Kutch in Gujarat, Thana and Kolaba districts in Maharashtra and in some parts of Goa, no significant deposits of bauxite are known to occur in the laterite which spreads over extensive areas along the coastal tracts of the country. The high level bauxite is found in the plateau regions bordering Bihar and Madhya Pradesh, the Maikala hills of Madhya Pradesh, the Western Ghats and the Eastern Ghats. The smaller and isolated areas, where plateau laterite and bauxite occur, are the Kharagpur Hills of Bihar ; the Seoni Plateau, the Bailadila Range, the Kaimur Plateau and the Malwa Plateau of Madhya Pradesh ; the Khariar Highlands of Orissa ; and the Shevaroy Hills of Tamil Nadu. In extra-peninsular India bauxite deposits are recorded in Jammu. Geology

By the very nature of its occurrence bauxite has developed as thin, irregular and discontinuous lenses or tabular bodies within the laterite cappings. It also forms detached congregations of boulders in the thicker laterite and gives rise to low mounds and hillocks as at Katni.

3.2 India's proved bauxite reserves amount to 155.6 MT (Table 3.1), out of which about 65 MT is of high grade. Of the total reserves, 81.3% are located in four States viz., Maharashtra (31.3%) Madhya Pradesh (28.7%), Bihar (11.8%) and Gujarat (9.5%). Tamil Nadu, Goa, Mysore and Orissa, together, have 16% of India's reserves, while the remaining 2.7% only is from other States. The first four States also have the lion's share (94.5%) of high grade bauxite reserves of the country. India's Resources

3.3 The largest proved reserves of bauxite in India are encountered in Maharashtra. These reserves amount to 48.7 MT. The bauxite is found in the districts of Kolhapur, Satara, Kolaba, Ratnagiri and Thana. Of the 13.9 MT of high grade ore in Maharashtra, Kolaba, accounts for about 6 MT, Kolhapur 3.5 MT and Satara 4.4 MT. The high grade ore contains over 50% alumina and is metal grade bauxite. Some of the bauxite deposits located in Kolaba district are of chemical and metallurgical grade containing more than 52% of Al_2O_3.

Maharashtra

Table 3.1 : Reserves of Bauxite in India

(In million tonnes)

State	High Grade	All Grades (including high grades)	% Share (for all grades)
All India	65.7	155.6	100.0
Maharashtra	13.7	48.7	31.3
Madhya Pradesh	19.5	44.6	28.7
Bihar	17.1	18.4	11.8
Gujarat	11.8	14.8	9.5
Tamil Nadu	0.6	8.6	5.5
Goa	N.A.	7.2	4.6
Others	3.0	13.3	8.6

Source : Geological Survey of India.

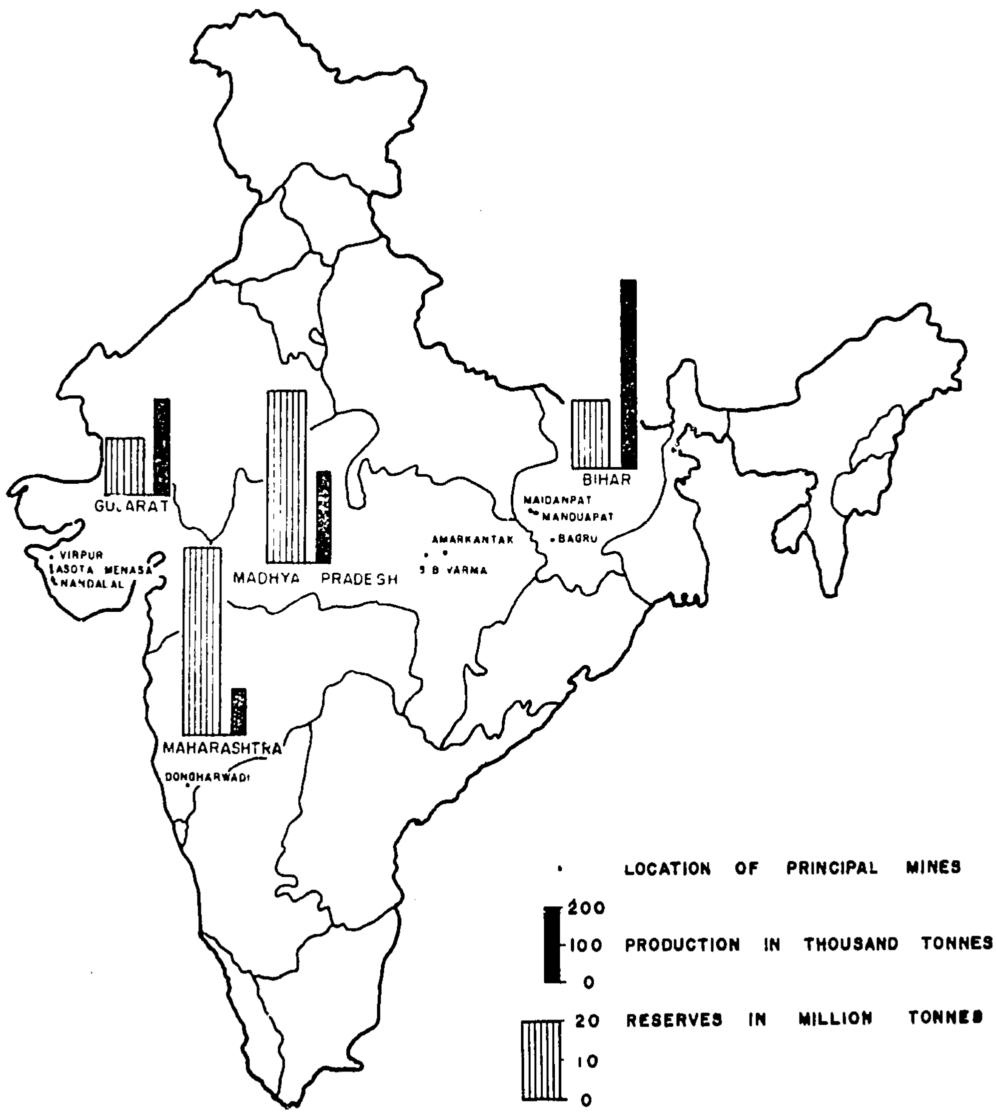
3.4 Next to Maharashtra, Madhya Pradesh has large quantities of proved bauxite reserves. The reserves here are of the order of 44.6 MT. The bauxite deposits of Madhya Pradesh occur In the districts Surguja, Raigarh, Bilaspur, Shahdol, Durg, Mandla, Balaghat, Jabalpur (Katni area), Rewa, Satna, Panna, Bastar, Bhopal, Guna, Shajapur and Shivpuri. Out of all these only the first eight areas are of major interest. They collectively hold at least 19.5 MT of metal grade ore.

Madhya Pradesh

3.5 With 18.4 MT of reserves, Bihar comes third in the reserve distribution in the country. The bauxite deposits occurring in the laterite cappings on the west side of the Ranchi district and on the adjoining highlands of the Palamau district form the most important ground with respect to exploitation at present. A conservative estimate of the reserves of metal grade bauxite is of the order of 17.1 MT.

Bihar

LOCATION OF PRINCIPAL BAUXITE MINES, RESERVES & PRODUCTION BY STATES, 1970



3.6 Gujarat has known reserves of about 14.8 MT, out of which 11.8 MT are of high grade. Gurjarat ranks fourth in the bauxite reserves of the country. Bauxite is known to be associated in the laterite caps occurring along the coastal tracts of Saurashtra, Kutch and in the districts of Kaira, Broach and Surat in the form of isolated patches or strips. In Saurashtra commercially important deposits have been located along the narrow strip running for 48 km from Virpur near the Gulf of Kutch to Lamba near the Arbian sea. The important deposits are in the vicinity of Ran, Mewasa, Habardi, Nandana and Lamba in Jamnagar district. In Kutch, too, the bauxite belt extends nearly for 50 km along its south-western margin. It comprises the important deposits of Lakhpat and Nakhatrana. The high grade bauxite reserves in Kutch are about 4 MT.

Gujarat

3.7 Of the other States, Tamil Nadu, Goa, Mysore and Orissa individually contribute 8.6, 7.2, 5.6 and 3.5 MT respectively, together amounting to 16% of the country's total proved reserves. Uttar Pradesh, Jammu and Kashmir and Kerala share the remaining 2.7% of the reserves. The Tamil Nadu bauxite is generally of fairly low grade with Al_2O_3 content varying between 40 and 50%. The Al_2O_3 content in bauxite of Mysore generally averages 45 to 52%, of Orissa 49 to 52%, of Uttar Pradesh 44 to 61% and of Kerala 40 to 58%. The State of Jammu and Kashmir has bauxite with highest Al_2O_3 content, ranging between 75 and 80%.

4. Structure of Bauxite Mines in India

4.1 In India, 62 bauxite mines were operating by the end of 1970. All the various types of organisation—proprietor-ship, public limited and private limited—are noticed in this mineral. The number of private sector mines exceeds by far that in the public sector, the available figure for the latter being only four. In public sector the ownership belongs to both State and Central Government undertakings. The total number of bauxite mines covered under the present study is twenty.

Nature of Ownership

4.2 Many of the bauxite mines work on small lease areas producing only a few thousand tonnes per annum. The very nature of the occurrence of ore in small concentrated, discontinuous and widely scattered pockets, often with hard laterite above, restricts the scope for mechanisation in mines. Thus a majority of mines work either manually or with semi-mechanisation. The latter is also generally limited to use of a compressor and a few jackhammers. Although possible, the hard rock as overburden does not permit the full utilisation of equipment such as bulldozers, excavators, etc. Similarly, use of trolley lines have been found to be economically justified only in larger pockets with big ore deposits. Depending upon the degree of mechanisation, it is observed that the production of mines varies from 10,000 tonnes to 75,000 tonnes per year. Of all the mines visited during the present survey, only two were found to be mechanised employing heavy machinery such as shovels, dumpers, wagon drills, crusher engines, conveyors and rope-ways. But it is seen that both these mines are captive ones. Situated in Bihar, these two mines are Bagru Hill and Manduapat, of

Type of Working

Degree of Mechanisation

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Indian Aluminium Co. Ltd. and Hindustan Aluminium Corporation Ltd. respectively.

Method of Mining

4.3 The bauxite mines are all opencast. The height of the benches in bauxite mines usually varies between 3 and 6 metres. As already mentioned, mining in the majority of cases is manual or semi-mechanised. Hence sorting of pieces into different grades is also visual. Except in highly mechanised mines like Bagru Hill, crushing and screening facilities are not provided. In some of the mines quality maps based on the 'cut-off' grade are prepared. For this the data is collected from test-pits and bore-holes. Depending on this information the ore is won from different blocks and portions and blended so as to get the required composite grade of 'run-of-mine'. Almost all the mines work for only one general shift, except mechanised mines where a second shift is worked for blast-hole drilling, loading and transportation by rope-ways.

Explosives

4.4 It is observed that both the quanity and varieties of explosives used in bauxite mines are limited. The commonly used explosives are gelatine, gun-powder and liquid oxygen with ordinary and electric detonators and safety fuses. High density explosives of the nature of slurry have not found much use in bauxite mining.

4.5 The large number of small mines has its impact on the employment structure. Data available from the Directorate General of Mines Safety indicate that during 1968 about 80% of bauxite mines had a daily average employment of 150 persons or less (Table 4.1). Out of this, the number of small mines which employ less than 50 persons per day on an average, is very significant. They total about 46.3% of all the bauxite mines in the country. The mines having average daily employment between 251 to 400 persons are only 5%, whereas not a single one was recorded with employment of more than 400 persons per day. Out of the mines covered under the present study, all but one had figures below 400 persons per day. The productivity per man-shift varies considerably. Starting from an average production of about 0.6 tonnes per man-shift in a non-mechanised mine, it reaches almost 3 tonnes in a fully mechanised mine. The average comes to 0.9 to 1 tonne in many of the semi-mechanised mines. Labour scarcity was not reported in any of the areas surveyed.

Table 4.1 : Distribution of Bauxite Mines by Employment Group (1968)

Employment Group	Number of Mines	Percentage
Up to 50	19	46.3
51 to 150	14	34.1
151 to 250	6	14.6
251 to 400	2	5.0
Total	41	100.0

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

4.6 Accidents of various nature are reported from the bauxite mines. As in iron ore and other minerals, only the bauxite mines having higher degree of mechanisation are found to be susceptible to accidents resulting in serious injuries. Number of fatalities is very small. It is also recorded that the rate of serious injuries has been fluctuating. The number of such injuries, now, comes to 0.9 per thousand per year. The major cause is faulty machine handling.

Accidents

5. Production Trend and Grade Structure

5.1 The distribution of bauxite mines in the country is quite non-uniform. The bauxite mines are operating in eight States, but 76% of them are located in three States, viz. Gujarat, Madhya Pradesh and Bihar (Table 5.1). The maximum concentration of mines is in Gujarat which accounts for about 42% of the 62 mines in the country. Although the sizes of mines vary over a considerable range, the majority of them are of small to medium size. However, there are a few large mines most of which are situated in Bihar.

Distribution of Mines

5.2 Production of bauxite in 1970 was 1,434.6 thousand tonnes as against 1,063.1 thousand tonnes in 1969. A cross analysis of the number of mines and production in the major States is interesting. Bihar, which accounts for 16% of mines and ranks third in this respect, tops the list as the largest producer, whereas Gujarat comes second in production although it has the maximum number of mines in the country. Madhya Pradesh with eleven mines produces just less than Gujarat. Bihar contributes about one-third of India's production, while each of Gujarat and Madhya Pradesh accounts for about one-sixth (Table 5.2).

Table 5.1 : Number of Bauxite Mines Operating During 1966-70

State	1966	1967	1968	1969	1970	
					No.	%
Gujarat	8	11	16	25	26	42.0
Madhya Pradesh	13	12	10	10	11	17.9
Bihar	9	10	9	10	10	16.1
Goa	NA	NA	2	5	5	8.0
Maharashtra	1	1	2	4	5	8.0
Mysore	1	1	1	2	2	3.2
Tamil Nadu	1	1	1	2	2	3.2
Uttar Pradesh	1	NA	NA	1	1	1.6
All India	34	36	41	59	62	100.0

NA—Not available

Source : (1) DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1966, 1967 and 1968.

(2) IBM— Mineral Statistics of India, 1969 and 1970.

Table 5.2 : Production of Bauxite During 1961-70
All India and Major States

(In thousand tonnes)

Year	All India		Bihar		Gujarat		M. P.		Maharashtra	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%	Qty.	%
1961	475.9	100.0	153.7	32.3	249.9	52.4	42.4	8.9	27.3	5.7
1962	586.8	100.0	218.1	37.2	295.1	50.3	65.1	11.1	2.8	0.5
1963	566.7	100.0	275.0	48.5	183.1	32.4	92.8	16.4	2.4	0.4
1964	593.5	100.0	337.6	56.9	108.0	18.2	95.5	16.1	0.9	N
1965	706.6	100.0	322.3	45.6	180.3	25.5	109.3	15.5	1.3	N
1966	749.9	100.0	379.7	50.6	171.8	22.9	107.5	14.3	9.0	1.2
1967	801.1	100.0	403.7	50.2	130.8	16.3	174.3	21.7	23.5	2.9
1968*	957.6	100.0	463.6	48.4	151.3	15.8	183.7	19.2	45.9	4.8
1969*	1,063.1	100.0	451.5	42.5	247.5	23.3	172.6	16.2	9.3	N
1970*	1,434.6	100.0	493.1	34.8	244.5	17.0	236.0	16.4	121.3	8.4

* Including Goa

N– Negligible

Source : IBM—Mineral Statistics of India, January 1971.

5.3 Production of bauxite shows an increasing trend over the last ten years. As against 387.4 thousand tonnes in 1960, the production in 1970 was 1,434.6 thousand tonnes, a growth by 270%. An yearwise analysis indicates that except for 1963, there has not been a fall in the production of bauxite from year to year. The fall in 1963 was of only 20 thousand tonnes. This was mainly due to a fall in production in Gujarat. During 1963, both Bihar and Madhya Pradesh had a significant rise of about 85 thousand tonnes together. But in the same year Gujarat witnessed a fall of the order of 112 thousand tonnes.

5.4 Bauxite trade in Gujarat has been export oriented. Exports take place from the ports of Okha and Porbandar. The roads to these ports are good. However, inadequate handling and loading facilities at these two ports have limited the exports and hence the production. The ports are not provided with adequate stacking facilities. The want of adequate facilities coupled with the downward and competitive conditions in the foreign markets further aggravated the situation resulting in decline in production of bauxite during 1963 to 1967. During this period leading smelters in Europe and Japan faced problems of undisposed stocks of alumina and aluminium.

Malaya and Indonesia had considerably cut down their prices. France, Greece, Yugoslavia and West Africa had also offered competitive rates. To add to this it is reported that on account of waiting time lost by the steamers at Okha, several foreign buyers had turned away, for their supplies, from India to other countries like West Africa and Australia. However, from 1967 onwards, Gujarat has started increasing its production.

5.5 The conditions in Bihar are different. The mines producing large quantities are all captive to various plants manufacturing alumina or aluminium in the country. Thus along with the enhancement of production of such plants their mines also have had to produce more. As a result the mines are either fully mechanised or have considerable mechanisation, resulting in increase in production.

Public Sector Vs. Private Sector

5.6 In bauxite, most of the mines at present are in the private sector. The mines in the public sector belong to various Government bodies, e.g. the Gujarat Mineral Development Corporation and Hindustan Steel Ltd. But their contribution is very small, amounting to only about 2 to 3%. But as this is a Schedule A mineral with strategic importance, it is expected that public sector will come in in a greater way in the future.

Grade

5.7 As regards the grade of ore, Gujarat largely produces bauxite averaging 55 to 60% Al_2O_3 content. In the presence demand, it also produces bauxite with average Al_2O_3 content of 52%. In other States the ore won is usually of 50 to 52% Al_2O_3 content. As the Gujarat bauxite is stated to be ricn in the trihydrate of aluminium (gibbsite), it is specially suited for the manufacture of aluminia. But the major part of production is of above 55% Al_2O_3, suitable for the refractory and chemical industries.

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6. Processing of Bauxite

Necessity for Beneficiation

6.1 It is seen that India possesses proved reserves of bauxite of the order of 155.6 MT out of which only about 65 MT are of high grade. In the matter of reserves of high grade ore, India has only 1.1% of the world's total, which appears inadequate to sustain, for a long time, bauxite based industries in the country. The Committe on Mining and Minerals, set up by the Joint Planning Board, has also expressed a similar view very recently (January 1971). The Committee has reported bauxite reserves of all grades of measured and indicated categories as 125 MT. The Committee has further remarked that if the production level was assumed at 500,000 tonnes per annum from the end of the Fifth Plan, the deposits would last 23 years. The result is based on the fact that normally six tonnes of bauxite are required to produce one tonne of aluminium metal. If this is so India needs to upgrade its low grade ores. It is also understood that if Indian aluminium plants can utilise bauxite down to grade 40% TAA (Total Available Alumina), the usable resources of the country may be doubled.

6.2 The only way of raising the grade of ore is by adopting the process of beneficiation. But according to available information, very few experiments have been carried out on beneficiation. There have been three studies carried out so far for beneficiating bauxite. Studies of bauxite samples from Gandhmardan and Chandgiri areas were conducted by the Directorate of Mines, Government of Orissa, using a hand jig and a floatation machine. Similarly, the National Metallurgical Laboratory, Jamshedpur has completed work on the beneficiation of bauxite samples from Roadside mine, Jabalpur and the Amarkantak mine. The details of the investigations are not available.

7. Cost and Price Structure

7.1 Data from the selected bauxite mines covered during the survey shows that the mining cost does not vary much from mine to mine for the majority of the mines covered (Table 7.1). In contrast, mining cost varies considerably in manganese and mica mines, although the deposits in all the cases are of irregular, pocket type. However, the analysis of mining cost data has been made and presented mine-wise.

7.2 The mining cost in bauxite mines, as in other minerals, depends on the richness of the deposit, depth of the mine, ratio of waste to ore, the method of mining (mechanised or non-mechanised) and the scale of operation (the level of production). Of the mines for which data is presented, the first two are highly mechanised (Table 7.1). Of the rest, four mines have different degrees of semi-mechanisation. The last mine is manually operated. The first mine is the most mechanised of all ; at the same time it has the maximum production, followed by the second mine. The costs at both these mines were lower than at the other mines during the last two years. The manually operated mine incurs about two

times the cost at the above mines. The sixth mine, though semi-mechanised, has a cost higher than the last (non-mechanised) mine in 1969, but lower in 1970. The production of the seventh mine is much higher than that of the sixth.

7.3 From these it is evident that the inter-mine variations in the mining cost of bauxite are caused by the extent of mechanisation as well as the production level. Mechanisation has, definitely, brought down the cost but where production is significantly high, the other mines with lower degree of machanisation also produce ore at competitive costs. However, bauxite mining cost behaves unlike that in iron ore in which it is observed that the mining cost in mechanised mines does not appear to be lower than in non-mechanised mines in all cases. The probable reasons, in iron ore, appear to be that such mines have been working below their capacity and there have been reported cases of breakdown due to mechanical trouble or power failure. The mining cost of bauxite in relation to degree of mechanisation and production level, thus, also helps to validate the above observations made in the case of iron ore.

7.4 It is also interesting to see the variation in mining cost of individual mines in the last two years. It is found that in most of the cases where the production of the mine has been stepped up in 1970, the mining cost has come down during 1970 from that in 1969. Evidently, in the mines whose production fell, mining cost has gone up. Also cases have been recorded where along with the production, cost has also increased, and the principal factors are probably the labour intensive process and depth of the mine.

Table 7.1 : Mining Cost of Selected Mines

Rs. per tonne

Sr. No.	Year	
	1969	1970
1	6.30	6.40
2	6.75	6.60
3	7.28	6.66
4	7.28	6.66
5	8.22	8.36
6	13.50	12.50
7	12.00	14.00

Source : ORG Mineral Survey.

7.5 Although there has been closeness in the mining costs at bauxite mines, f.o.r. costs at surveyed mines show a different picture. There is considerable difference in the f.o.r. costs at these mines. This is noticed even among the mechanised **f. o. r. Cost**

mines. This variation is accounted for by the difference mainly in establishment cost, capital investment and transportation cost. Since the f.o.r. costs do not act in a similar way, data for each mine is presented separately in Table 7.2.

Table 7.2 : F.O.R. Cost of Selected Mines

(In Rs. per tonne)

Sr. No.	Type	1969	1970
1	PT/C/M	19.50	20.00
2	PT/C/M	26.90	26.40
3	PT/C/S	44.75	44.94
4	PT/C/S	44.75	44.94
5	PT/C/S	24 13	23.54
6	PT/S	29.65	30.20
7	PT/N	20.15	22.15
8	P/C/N	40.03	39.49

PT = Private Sector M = Mechanised
P = Public Sector S = Semi-mechanised
C = Captive N = Non-mechanised

Source : ORG Mineral Survey

7.6 There is insufficient data available on f.o.b.t. cost and f.o.b.t. price. This renders it difficult to analyse f.o.b.t. cost/price structure. However, during discussions, mineowners and exporters represented that unless the facilities for transport of ore from mines to the ports and ore-handling and loading at the ports are improved and the development of ports for deeper draft carriers taken on hand, the f.o.b.t. cost of bauxite will make it difficult to compete in the world market. As a result bauxite export is likely to suffer, though the Indian ore quality is better than that of many other of her competitors.

8. Marketing and Transportation

Internal Consumption

8.1 The internal consumption of bauxite depends mainly on the intake of aluminium plants. It also depends upon various other industries, e.g. chemicals, cement, abrasives and refractories. By the end of the Second Plan (1960-61) production of aluminium was about 18.3 thousand tonnes. It had risen by 240% by 1965-66 and by 585% by 1968-69, with metal production of 62.1 and 125.3 thousand tonnes in the respective years. This large scale increase in the capacity of the country to produce aluminium gave a fillip to the production of bauxite. Aluminium manufacture is expected to be doubled by 1973-74.

8.2 The export of bauxite ore can be considered a trade of only the last decade so far as India is concerned. However, the export has not shown any steady trend during this period, even though the world demand has been increasing

during these years and Indian ores are better suited for the aluminium industry than those of many other countries. Bauxite export reached its peak in 1962 when 249.1 thousand tonnes were shipped, valued at Rs. 8.55 million. Thereafter there was a continuous decline up to 1965. The export then stood at 62.8 thousand tonnes worth Rs. 1.8 million. With some fluctuations during the intervening period it rose to 98.9 thousand tonnes in 1968. But in the following year the export again came down, to 67.7 thousand tonnes (Table 8.1). Export

Table 8.1 : Export of Bauxite during 1960-69

(Quantity in thousand tonnes)
(Value in thousand rupees)

Year	Quantity	Value
1960	75.6	2,799
1961	99.3	3,985
1962	249.1	8,552
1963	135.2	4,758
1964	94.4	3,086
1965	62.8	1,801
1966	77.9	2,490
1967	60.9	2,560
1968	98.9	4,431
1969	67.7	3,349

Source : IBM—Mineral Statistics of India, October 1970.

Japan, West Germany, Italy and the UK are important buyers of bauxite from India. Since 1959, Japan has emerged as the principal buyer. East European countries also have shown interest in purchasing India's bauxite. Gujarat has remained the principal exporting State of the country during the last decade. Out of India's total export of 249.1 thousand tonnes in 1962, Gujarat alone accounted for 207.9 thousand tonnes. Gujarat exported 77.6 thousand tonnes in 1966-67 and 80.1 thousand tonnes in 1968-69 out of India's total of 82.8 and 112.1 thousand tonnes respectively.

8.3 In terms of quality, Indian bauxite is better than that of its competitors such as Greece and Yugoslavia, which produce monohydrate as against the trihydrate of India. However, on account of various factors such as lack of good transport, loading/unloading and storage facilities, and proper port facilities, bauxite export is handicapped. Some of these factors also pose problems in marketing the ore within the country. **Problems**

8.4 Transportation is one of the biggest problems faced by this industry. Distance to the nearest railway station and lack of a good approach road are contributing factors. Except at fully mechanised mines, mechanical loading facilities do not exist. The approach roads from mines to highways or loading points vary in length from 1 km to 20 km. Also they are very poor, generally being only fair weather roads. During the monsoon season there is no mining activity in a number of mines, both because of flooding and poor surface conditions of the roads. Especially in Gujarat, where the industry is export oriented, such closure of the mines is a regular feature every year and idle periods vary from a month to four months.

Lack of Good Transport

The distances from mines to nearest railway sidings vary from 10 km to 50 km. Such long distances and poor approach roads have resulted in high transportation cost. Data obtained shows that the transportation cost, from mines to railway stations ranges from 15 to 49% of the f.o.r. cost. To bring down this transportation cost, the first necessity is to improve the existing approach roads. Another remedy would be to extend the rail-links up to the area of concentration of mines to decrease transportation by road. It is quite obvious that transportation by railway is cheaper than by road.

8.5 Storage facilities at railway stations are highly inadequate at many of the railway stations. As noticed at the stations like Bhatia and Bhopalka (in Gujarat) the plots allotted to different mines are so small as to accommodate material up to only 2 to 3 wagon loads. When wagons are supplied, this stock is too small for the number of wagons to be loaded. As a result the wagons have to wait for new material to come, thereby causing delay in time as well as raising the cost.

Inadequate Storage Facilities

8.6 Shortage of railway wagons is yet another problem. It has been adversely affecting the industry. Inadequate supply of wagons leads to stock piling up both at the railhead and at the mine-head. Where limited stacking facilities are provided at railway stations, the stocks would gather at the mine-head instead. Since the contract entered into by the mineowners are generally on f.o.r. basis (excepting on f.o.b. basis for export goods), piling up of stock would mean blocking the flow of finance to the mineowners, which affects their day to day working. Stocking of the ore for a longer period, further, increases the extent of loss.

Shortage of Wagons

8.7 There are many difficulties incident on export of bauxite. The major export oriented bauxite mining areas are centered nearer to ports like Okha, Salaya and Porbander in Gujarat and Shrivardhan in Maharashtra where there are poor draft conditions. The steamers have, therefore, to be loaded off-shore, while on the other hand the transporting facilities from harbour to the ship are quite insufficient. Indeed, the distance from the mining areas to the bigger ports with reasonable draft unfavourably influences the price of Indian bauxite. It is understood that, at present, Port Okha can handle only up to 800-900 tonnes per day. It is estimated that the port should have a handling

Port Facilities Inadequate

capacity of at least 3000 tonnes a day to meet the present mine owners' requirements. Also needed are adequate stacking and handling facilities at the port. Unless this is done, export of Indian bauxite will find it difficult to compete with other countries, which have superior port facilities and less ocean freight charges than ores from India.

9. Future Prospects

9.1 As at present, the aluminium manufacturing units will be the major bauxite consuming centres in the future. Therefore the requirement of bauxite is studied in the light of growth of this industry. The production of aluminium in the country is expected to be raised from 125 thousand tonnes in 1968-69 to 220 thousand tonnes in 1973-74, the end of the Fourth Five Year Plan. The same is expected to rise to 450 thousand tonnes in 1980-81. The production programme of 450 thousand tonnes from primary producers is provisionally expected to be distributed as in Table 9.1.

Table 9.1 : Requirement of Bauxite of Aluminium Plants in India - 1980-81

(In thousand tonnes)

Plant	Capacity	Production	Requirement of Bauxite
Hirakud	20	19	110
Alwaye	16	15	90
Belgaum	100	95	550
Asansol	12	12	65
Renukoot	120	114	660
Mettur	25	24	135
Korba	[illegible]	95	550
Koyna	50	48	275
Gujarat	30	28	165
Total	473	450	2,600

Source : 1. Report, Department of Mines and Metals, 1970-71.
2. Commerce, 1970.

9.2 The preliminary appraisal of bauxite deposits in most of the mining districts is nearly complete and areas of potential deserving detailed proving are known in fair detail. However, the work on assessment of bauxite reserves, for the proposed and even existing aluminium plants, as reported has not been of the same standard everywhere, and there is not sufficient information. Detailed work has been carried out in only a few places. Since an assured and steady supply of

bauxite is essential for the fast development of the aluminium industry, care should be taken to ensure sufficient captive sources for the units. This can be done by proving of reserves for 10 years in advance in captive sources for each aluminium plant in existence or expected to come up soon. This works out to as indicated in Table 9.2.

Table 9.2 : Demand Pattern

(In thousand tonnes)

Supplying Area	Demand in 1980-81	Reserves to be established by 1980-81
Ranchi-Palamau	465	4,650
Amarkantak	460	4,600
Bilaspur	550	5,500
Salem-Nilgiri	135	1,350
Belgaum-Kolhapur	825	8.250
Gujarat	165	1,650
Total	2,600	26,000

Source : ORG Mineral Survey.

As stated earlier, the preliminary estimates of reserves in the above districts have already been done. It is, however, heartening to note from the experience that detailed explorations have resulted in substantial upward revision of preliminary estimates. Detailed and recent investigations have been undertaken in a few areas by various agencies, and further work has to be based on that.

Use of Low Grade Bauxite

9.3 A fact which emerges from the overall position of high-grade (50% and above) and all grades of reserves (45% and above) as estimated now, which has already attracted the attention of the industry, is the necessity to utilise the lower grades of ore also in the aluminium industry in future. It is estimated that for every 5% lowering of alumina content the usable reserves of bauxite may get more than doubled. The relatively large tonnage of lower quality ore that at present is not being utilised can to a great extent be put to use as technology improves. In order to help accomplish this, it is a matter of high priority to get necessary studies undertaken on beneficiation with adequate technical and financial support.

Characteristics of Bauxite

9.4 The chemical and mineralogical characteristics of bauxite are very important criteria in determining the requirements of bauxite for manufacture of alumina. These also affect the requirements of caustic soda, electricity, water as well as capital for the plant. Though Indian bauxite in general is of trihydrate form, a considerable quantity of monohydrate is associated. This results in higher

requirements of bauxite, caustic soda, electricity, etc. for proper digestion of the ore. These problems can be solved to an extent by proper mineralogical analysis of all the commercially exploitable bauxite, and thereby working out carefully in advance the digestion characteristics of the ores.

Public Sector Contribution

9.5 The programme in the public sector envisages the establishment of two smelters at Korba and Koyna with alumina production facilities. The two plants together will utilise about 825 thousand tonnes of bauxite per annum by 1973-74. In view of substantial deposits of good grade bauxite in Kutch and Saurashtra an export oriented alumina plant with an annual capacity of 30 thousand tonnes has been proposed in the area. This plant will require about 165 thousand tonnes of bauxite annually. Therefore along with the private sector, the public sector will also, now, play an important role in the production of bauxite.

Export

9.6 As discussed elsewhere, bauxite export suffers because transport and handling facilities are inadequate. The capacity of present bauxite exporting ports like Okha, is about 800 to 900 tonnes per day. It is felt that to cope with the demand and to find new markets, the ports should be designed to handle a minimum of 3,000 tonnes per day. The market is not going to be a problem. Western Europe, which is one of our principal buyers, is to augment its production of aluminium by about 2.2 MT by 1972. Similarly, Japan has also become one of our major purchasers.

9.7 In view of the plans and the bright prospects for the growth of the domestic aluminium manufacturing industry, a long range policy with respect to the export of bauxite needs to be evolved. Any improvement of export facilities should be consistent with this policy.

CHAPTER V—KYANITE

1. Introduction

1.1 India plays a very significant role in the world kyanite industry. In terms of value of minerals produced in the country its contribution is only 0.4% of the total. Among the non-fuel minerals, its contribution is 2.2% of production and its addition to the national income is only 1.9%. The kyanite industry was till recently export oriented. However, its share to the total value of minerals exported was only 1.2% in 1970. Domestic consumption of kyanite is growing and the demand for the mineral is increasing with the setting up of industries requiring super refractories.

2. Brief Review of World Kyanite Industry

2.1 The USA and India are the two largest producers of kyanite. Kyanite is found mostly in India, African countries and in the United States. Known reserves of kyanite in India are of high grade. Kenya is one of the countries which has mined substantial quantities of kyanite since 1948 and has almost exhausted her deposit of kyanite. Kenya has started mining kyanite quartz schist, deposits of which are large.

World Trade

2.2 Almost the whole of Europe depends entirely on India and African countries for kyanite. The USA is the largest consumer of kyanite in the world. The U.S. deposits being entirely of a disseminated type, the USA imports Indian kyanite to produce coarse grained mullite.

Mention should be made that synthetic materials are gradually replacing raw kyanite in Europe and in the USA. Synthetic mullite prepared from bauxite and other materials is offering competition to natural kyanite and allied minerals. In the USA, substitute products are being made from fine grained Virginian mineral which compares well with those made from grained Indian kyanite.

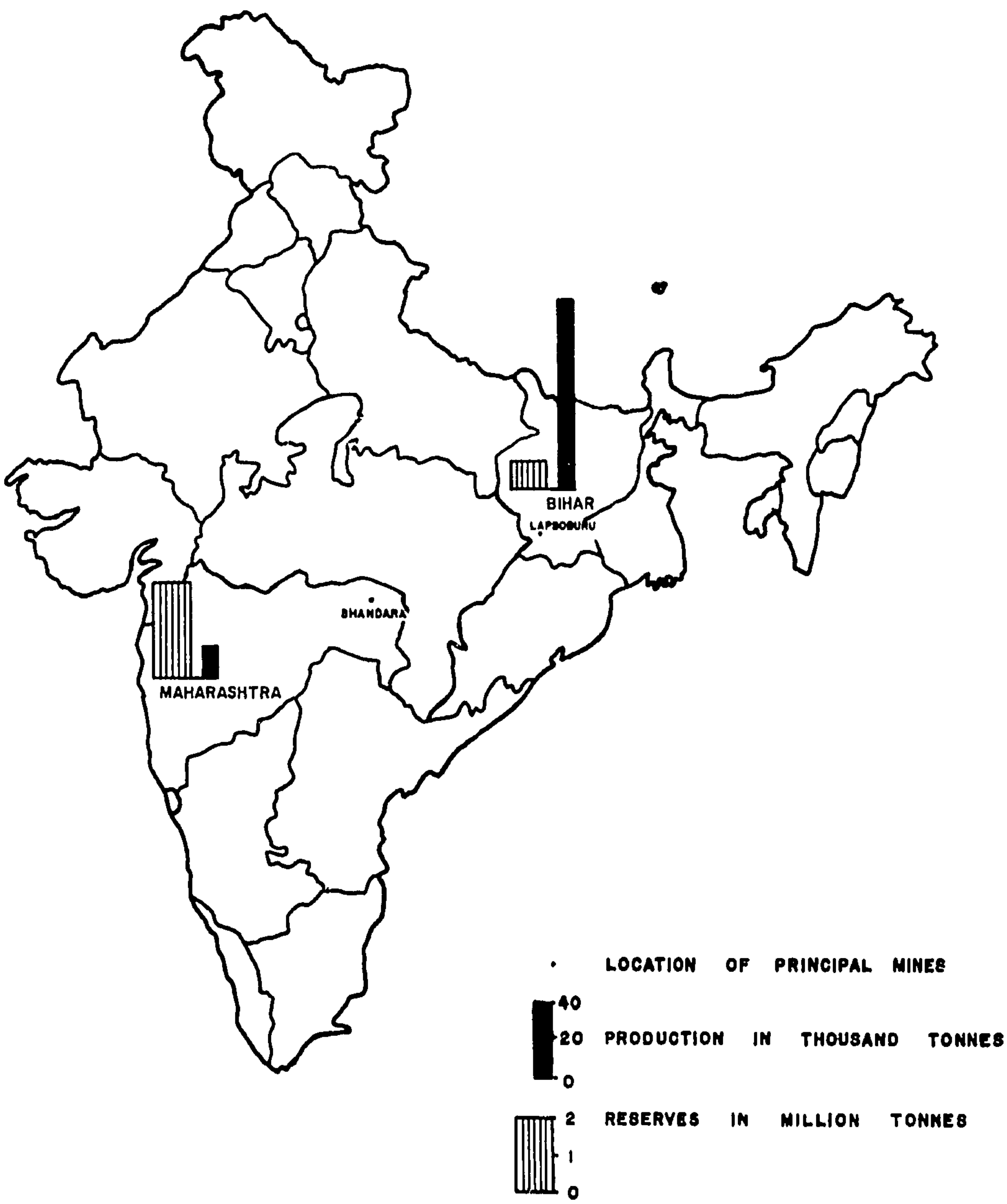
3. Geology and Reserves

3.1 Distribution of kyan[illegible]s not so wide spread as that of iron ore or manganese ore. Kyanite is found in a few States only. The total inferred reserves of kyanite in India are placed at 10.01 MT by the GSI. Important workable deposits are mainly confined to Singhbhum district of Bihar, while occurrences of minor importance have been reported from Andhra Pradesh, Maharashtra, Mysore, Orissa, Rajasthan, and West Bengal.

Bihar

3.2 The best deposits of kyanite are confined to Singhbhum district. The deposit at Lapsoburu, the largest of all, where production began in 1925, has been the chief world source for many years. Kyanite is known to occur in a belt about 130 km long and 16 km wide and follows the northern flank of the Singhbhum copper belt. Other deposits of massive kyanite in Singhbhum district are found near Ghagidih between Badia and Bakra and at Mohanpur. Deposits of lesser

LOCATION OF PRINCIPAL KYANITE MINES, RESERVES & PRODUCTION BY STATES, 1970



importance are found at Rakha mines, Chirugora, Bhakra, Shirbai, Padampur, Kukudungri etc. A narrow zone of kyanite has also been traced in Dhanbad district, but the mineral is of little commercial value due to its high micaceous nature.

The earlier estimated reserves of kyanite at Lapsoburu, the largest producing area in the country, is placed at 0.7 MT down to 3 m. depth by the GSI. The Indian Copper Corpcration Ltd., which holds the lease in this area, had a proved reserve of 230 thousand tonnes by the end of 1969.

3.3 Small occurrences of kyanite are reported in Bhandara district. Poor quality kyanite is reported from Mogra, Girola, Ganglewara Sonekhari, Pawar Dawna and Sarethi in the district. The total probable reserves of kyanite-sillimanite have been estimated to be of the order of 2.5 MT. The entire potential of the kyanite deposit in the State is not yet known. **Maharashtra**

3.4 Bladed variety of kyanite occurs in Thirumalpur Taluk of Hassan district whereas massive faint blue kyanite associated with corundum occurs in Mavinkere Taluk of the same district. The reserves in the two areas are estimated to be not more than 50,000 and 250,000 tonnes respectively. The reserves in Holalkere Taluk in Chitaldurg district are placed at 460,000 tonnes and Kollegal Taluk in Mysore district at 30,000 tonnes. **Mysore**

3.5 Occurrences in the form of small veins and pockets of kyanite are reported from Orissa, Rajasthan, W. Bengal, Andhra Pradesh, Himachal Pradesh, Tamil Nadu and Haryana. These pockets are not suitable for commercial exploitation. **Other States**

4. Structure of Kyanite Mines in India

4.1 Kyanite industry in India is principally a venture of the private sector. There were 14 mines in the country mining kyanite during 1970. A kyanite mine in the Bhandara district of Maharashtra is operated by the Maharashtra Minerals Corporation, a joint sector organisation with 26% State's share. The biggest and the most important mine in the country, Lapsoburu, is being operated by the Indian Copper Corporation (ICC). This mine, located in the Singhbhum district of Bihar, has been in production over the last forty years. Most of the productive mines are located in Singhbhum district.

4.2 Kyanite occurs mostly on the surface. All the kyanite mines in Bihar are opencast with depths varying from 0.5 metre to 4.5 metres. In ICC mining is limited to hill slopes during the monsoon. Working in the lower regions is suspended during the rainy season because of water-logging in the pits.

The scope for mechanising a kyanite mine is quite limited due to the rather sporadic occurrence. The Lapsoburu mine is the only mine using mechanical equipment for mining purposes. It is a semi-mechanised mine. Jackhammers,

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compressors etc. are used while mining is done on the hill slopes where kyanite occurs in the form of massive rocks. It has been reported that in the other mines, mining is limited to the float ore and that it is mostly surface scratching. The workers are very skilled in separating kyanite from the waste rock.

Employment

4.3 The average daily employment in all the kyanite mines excepting the Lapsoburu (ICC) is below 150. Data available from the Director General of Mines Safety show that during 1968, 3 out of the seven mines operating at that time had an average daily employment of less than 51 persons and another three had an average daily employment of between 51 and 150. The Lapsoburu mine employs about 1100 persons for its mining activity and another 800 for sorting, grading etc. (Table 4.1).

Table 4.1 : Distribution of Kyanite Mines in India by Employment Groups (1968)

Employment Group	No. of mines
Up to 50	3
51—150	3
151—250	—
251—400	—
401—500	—
501—800	—
801—1200	1
Total	7

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

Safety

4.4 Accidents in kyanite mines are very rare because of the nature of the deposit and lack of mechanisation. Accidents with serious or fatal injuries have not been reported in the recent past. Minor injuries are caused mostly due to negligence of the workers.

5. Production Trend and Grade Structure

Concentration of Mines

At present Bihar, Maharashtra, Mysore and Orissa are the four States mining kyanite. Bihar, with 10 mines out of 14, is the largest producer of kyanite in the country. Maharashtra has two mines in Bhandara district and started mining operations in 1968. There is one mine in each of Orissa and Mysore.

Table 5.1 : Number of Operating Mines, All India and Major States, 1966-70

State	1966	1967	1968	1969	1970
Bihar	6	6	5	9	10
Maharashtra	—	—	—	2	2
Mysore	—	2	2	2	1
Orissa	1	—	—	—	1
All India	8	8	7	13	14

Source : (1) DGMS—Statistics of Mines in India, Vol. II, Non-Coal 1966, 1967 and 1968.
(2) IBM—Mineral Statistics of India, 1969 and 1970.

5.3 Production in India in 1970 was 119 thousand tonnes as against 84 thousand tonnes in 1969, an increase of 40%. Production of kyanite over the ten year period ending 1970 shows a gradual increase except during 1963 and 1967. A sudden spurt in activity, combined with a decrease in demand, during the previous years (1962 and 1966) resulted in increased stocks and decreased production in 1963 and 1967. However, since 1968 the production has picked up due to increased domestic consumption.

5.4 Bihar is the largest producer of kyanite in the country and accounted for about 86% of the country's production. Maharashtra with a share of 13% ranks next. Orissa and Mysore have a share of just 1%. Prior to 1969, Bihar produced about 99% of the country's production. Bihar produces the best quality kyanite in the country. Kyanite from Lapsoburu is rated as one of the best in the world.

Grade

5.5 Kyanite is a silicate of aluminium. Primary grading of kyanite is done on the basis of the alumina content. The standard grade kyanite has + 60% alumina and the poor grade has below 60%. The percentage of poor grade ore varies from area to area and region to region. Further grading is done on the basis of the size of the pieces.

6. Processing of Kyanite

Need for Conservation of High Grade Ore

6.1 The need for processing of low grade kyanite arises because of the limited reserves of high grade ore in the country. The Sub-Group IV on the Development of Minerals in the Fourth Plan has expressed concern over the limited reserves of high grade kyanite, and has recommended a complete stoppage of exports unless the reserves are augmented. This scarcity of high grade ore not only calls for conservation of existing reserves and extension of area exploited but also the use of existing ore in the most economical way.

Table 5.2 : Production of Kyanite During 1961-70—All India and Major States

(In thousand tonnes)

Year	All India Qty.	Bihar Qty.	Bihar %	Maharashtra Qty.	Maharashtra %	Mysore Qty.	Mysore %
1961	27.1	27.1	100.0	—	—	—	—
1962	49.7	49.7	100.0	—	—	—	—
1963	32.1	32.0	99.7	—	—	—	—
1964	34.1	33.5	98.2	—	—	—	—
1965	37.5	37.4	99.7	—	—	—	—
1966	63.8	63.5	99.5	—	—	0.2	0.3
1967	50.4	49.4	98.0	—	—	0.6	1.2
1968	64.4	64.1	99.5	—	—	0.3	0.5
1969	83.9	73.1	87.1	10.5	12.5	0.2	0.3
1970	119.0	102.2	85.9	16.5	13.8	0.2	0.2

Source : Mineral Statistics of India, January 1971.

6.2 Studies have been in progress on the possibility of beneficiating the kyanite of Maharashtra at the National Metallurgical Laboratory. It is reported that the kyanite can be beneficiated. The commercial feasibility of the process has yet to be worked out.

6.3 At present very little ore is being beneficiated and only removal of extraneous material done. As already mentioned, kyanite from Lapsoburu is predominantly of high grade and needs very little cleaning and washing.

7. Cost and Price Structure

7.1 A detailed analysis of the cost and price structure of the kyanite industry in the country has not been attempted due to the non-availability of data. However, it has been reported that the mining cost is about Rs. 100 per tonne. Kyanite mining is labour intensive. The f.o.r. cost is about Rs. 200 per tonne whilst the f.o.r. price is Rs. 280 to Rs. 300 per tonne. The low grade kyanite fetches a f.o.r. price of Rs. 100 per tonne. Unit value realisation for exported kyanite is quite high. The f.o.b. price is about Rs. 420 per tonne for the high grade kyanite.

8. Marketing and Transportation

8.1 The bulk of the demand, domestic as well as overseas, is for kyanite containing 60% and above alumina. Kyanite of lesser alumina content finds

negligible use at present. High grade or commercial grade kyanite is chiefly used as a refractory material in the form of mullite in furnaces used for melting glass and non-ferrous metals and in cement clinkering industries. It finds use in the manufacture of glass burner tips, spark plugs, heating elements and voltage electrical insulators and in ceramic industries.

Demand for High Grade Kyanite

8.2 Internal consumption of kyanite has registered a steady increase with the preference for natural kyanite instead of synthetic mullite by the Bokaro Steel Plant. Domestic consumption in 1969 was 35 thousand tonnes as against 7.8 thousand tonnes in 1966.

Increase in Domestic Consumption

8.3 Exports of commercial grade kyanite have been steadily increasing in the recent years. Total exports in 1970 was Rs. 24 million as against Rs. 7.5 million in 1965. Japan is the largest buyer of Indian kyanite with a share of 22.8% of the total exports of kyanite from the country. Italy, Belgium and the UK are the other major importers.

Increasing Exports

Table 8.1 : Exports of Kyanite 1965-70

Year	Quantity (thousand tonnes)	Value (Million Rs.)
1965	31.1	7.5
1966	35.7	11.1
1967	40.6	15.8
1968	50.5	18.9
1969	45.6	18.8
1970	57.2	24.0

Source : IBM—Mineral Statistics of India, January 1971.

The bulk of the kyanite consigned for exports is transported by road to Calcutta port. Domestic buyers make their own arrangements for transporting the mineral from the depot/mine site. Transport charges from the depot/mine site are borne by the buyers.

Transportation

9. Future Prospects

9.1 The domestic demand for high grade kyanite has been steadily increasing. Consumption in 1970 was almost double that predicted by the Sub-Group IV of Planning Group of Minerals for the year 1969-70. However, the reserves of high grade kyanite are limited. At the present rate of production, these deposits will last hardly more than 5—6 years. Low grade kyanite found in abundance could be mined and beneficiated. It has been reported that low grade kyanite found in Maharashtra can be beneficiated. However studies are still in progress on the economics of beneficiation and the possibility of commercial utilisation. It is expected that with the effective utilisation of low grade kyanite, the country would be able to meet her domestic and overseas requirements.

CHAPTER VI—LEAD-ZINC

1. Introduction

1.1 Low indigenous production of lead-zinc has forced the country to rely heavily on imports. India produces an insignificant 0.1% of the total world production. Of the total value of minerals produced in India, lead-zinc contributes only 0.2%. India's requirement of lead-zinc has been steadily increasing and has been placed at about 140 thousand tonnes for zinc and 100 thousand tonnes for lead by the end of the Fourth Plan. The shortfall in the availability from indigenous sources will be about 66 thousand tonnes and 92 thousand tonnes for zinc and lead respectively.

2. Brief Review of World Lead-Zinc Industry

Lead

2.1 World production of lead shows a gradual increase during the four years ending 1968. As against a total production of 2.75 million tonnes (MT) in 1965, production of 3.00 MT was reported in 1968, an increase of 8% (Table 2.1). The USSR is the largest producer of lead in the world, accounting for 13.3% of the total in 1968. The USA, Australia and Canada are the other major producing countries. India contributed only 0.1% of the total production.

2.2 The world demand for lead in 1968 was 3.6 MT, with a US demand of 898 thousand tonnes and an Indian demand of 60 thousand tonnes. It is estimated that the world demand in the year 2,000 will be 5.5—7.1 MT.

Zinc

2.3 World production of zinc shows a steady increase during the four years ending 1968. As against a production of 4.36 MT in 1965, production of 5.07 MT was reported in 1968, an increase of 14% (Table 2.2). Canada is the largest producer of zinc, accounting for 23% of the total production in 1968. The USA, Australia and the USSR are the other major producing countries. India contributed 0.3% of the total production.

2.4 The world demand in 1968 was 5.4 MT, with a US demand of 1.4 MT and an Indian demand of 80 thousand tonnes. It is estimated that the world demand in the year 2,000 will be 6.8—12.8 MT.

3. Geology and Reserves in India

India's Resources

3.1 Lead and zinc deposits are reported from most of the States in the country. The total estimated reserve of lead-zinc in India is about 110 MT, out of which 45 MT is proved reserve of 6% Pb-Zn. Important lead-zinc deposits are located in Rajasthan, Gujarat and Andhra Pradesh. Small deposits have also been reported from Orissa, Bihar, Tamil Nadu and Kashmir (Table 3.1).

Table 2.1 : World Production (Lead concentrates)

Country	Production (thousand tonnes)					
	1965	1966	1967	1968	1969	% Share (1968)
World Total	2,750	2,860	2,900	3,000	NA	100
USSR	350	375	400	400	NA	13.3
USA	273	297	287	326	462	10.8
Australia	368	370	382	387	451	12.9
Canada	275	293	308	327	300	10.9
Mexico	170	182	164	174	170	5.8
Peru	195	145	158	172	NA	5.8
Yugoslavia	106	103	108	112	115	3.7
Bulgaria	100	99	96	94	84	3.1
Morocco	78	80	80	80	80	2.6
India	4.1	3.8	3	2.7	2.5	0.1
Other countries	831	911	914	925	NA	31.0

NA—Not available

Source : (i) UN, Statistical Year Book, 1969.
(ii) UN, Monthly Bulletin of Statistics, Feb. 1971.

3.2 Rajasthan ranks first so far as Pb-Zn reserves are concerned. With 85.7 MT of inferred reserves she contributes 77.9% of the country's reserves. The most important ore bearing tract is in the neighbourhood of Zawar in Udaipur district. Vast deposits are found in Mochia, Balaria, Zawarmala and in the Rajpura-Dariba Block. The southern block of this belt has a proved reserve of 21.7 MT of 7-8% Pb-Zn and a probable reserve of 27.3 MT of 7-8% Pb-Zn. The mines in the Zawar region are principally noted for their zinc ores though argentiferous galena also occurs along with sulphides. **Rajasthan**

3.3 Andhra Pradesh ranks next to Rajasthan and accounts for 11.3% of the total reserves. The Bandalamottu deposit in Agnigundala, with an estimated reserve of 10 MT of 6.5% Pb and 1.4 MT of 3.1% Pb, is the most important lead deposit in India. The Dhukonda deposit has an estimated reserve of 0.46 MT of 8.98% Pb. **Andhra Pradesh**

3.4 The reserve of 6 MT of 8—10% Pb-Zn at Ambamata is the largest single deposit in Gujarat. Khandia in Baroda District has an estimated reserve of 0.22 MT of 4.5% Pb-Zn. **Gujarat**

Table 2.2 : World Production (Zinc concentrates)

Country	Production (thousand tonnes)					
	1965	1966	1967	1968	1969	% Share (1968)
World Total	4,360	4,520	4,900	5,070	NA	100
Canada	826	950	1,133	1,155	1,194	23.0
USSR	470	500	535	540	NA	10.7
USA	554	519	498	480	502	9.5
Australia	355	375	407	420	507	8.3
Peru	255	258	318	333	NA	6.5
Japan	221	254	263	264	270	5.1
Mexico	225	219	211	240	253	4 7
Poland	185	190	218	219	229	4.2
India	5.6	5.2	5.7	7.1	7	0.1
Other countries	1,363	1,250	1,311	1,412	NA	28.0

NA—Not available

Source : (i) UN, Statistical year Book 1969.
UN, Monthly Bulletin of Statistics, Feb. 1961.

Table 3.1 : Reserves of Lead-Zinc—All India and Major States

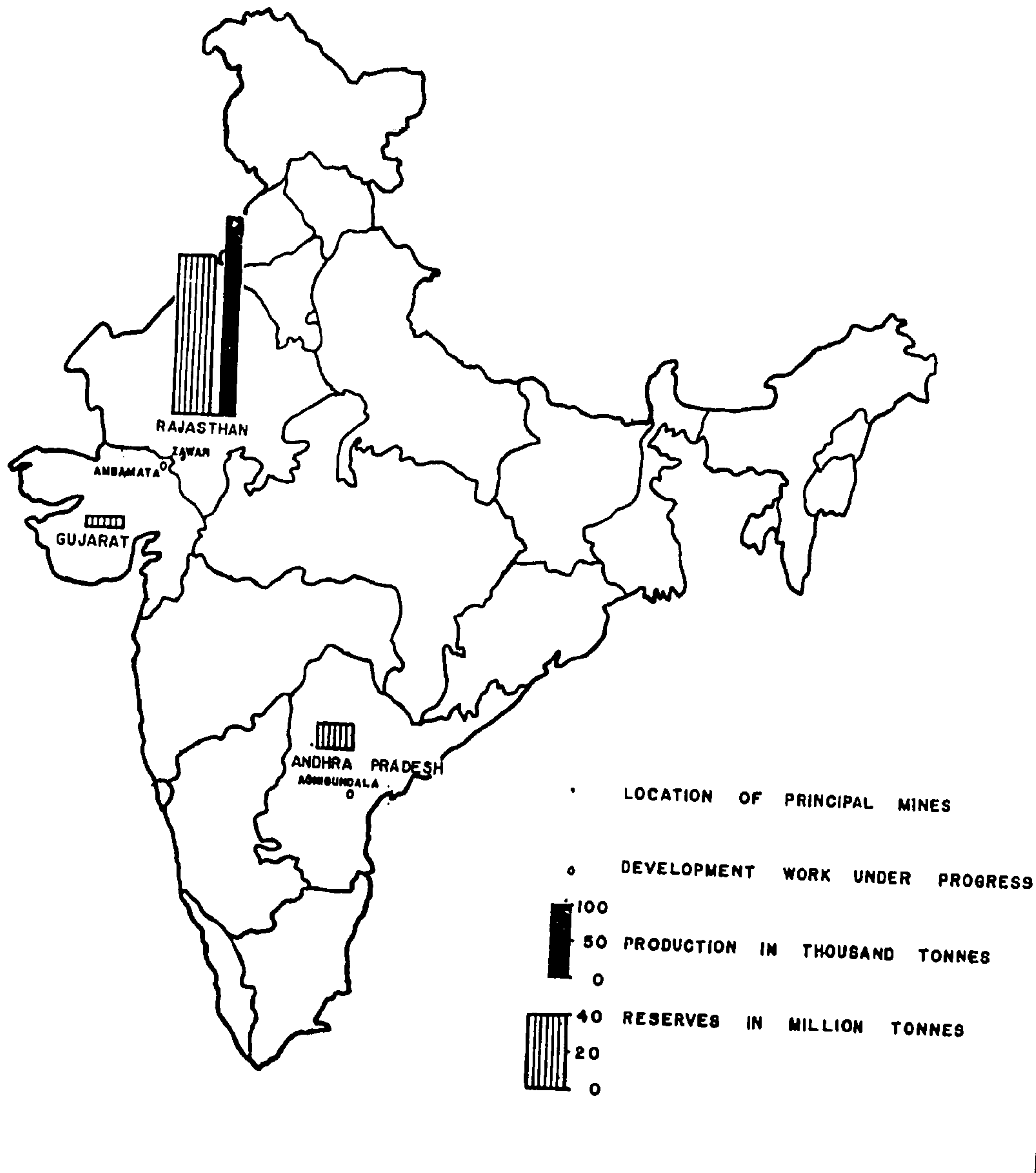
State	Metal content	Reserve in Million Tonnes	% Share
All India	6%	110.1	100.0
Rajasthan	6.8%	85.7	77.9
Andhra Pradesh	6.5%	12.5	11.3
Gujarat	8 to 10%	6.3	5.7
Orissa	—	4.7	4.3
Tamil Nadu	3.5%	0.9	0.8

Source : 1. (i) Geological Survey of India.
2. (ii) Hindustan Zinc Limited.

4. Structure of the Lead-Zinc Mining Industry in India

4.1 The Hindustan Zinc Limited (HZL), a Government of India enterprise, is the only unit in the country mining lead and zinc. The Gujarat Mineral Development Corporation, a Government of Gujarat enterprise has started developmental work at Ambamata.

LOCATION OF PRINCIPAL LEAD & ZINC MINES. RESERVES & PRODUCTION BY STATES, 1970



4.2 HZL, with an authorised capital of 10 crores, was formed in October 1965 to manage and develop the Zawar mines in Udaipur. HZL has three principal units located at Zawar, Debari and Tundoo, with its head office at Udaipur. **HZL**

4.3 Mining at Zawar started as early as 1945 when the area was leased to the Metal Corporation of India (MCI), a private concern. The company was taken over by the Government of India in 1965 to avoid delays in the commissioning of the Debari Smelter and to develop the Zawar mines, where work had been suspended by the MCI. **Zawar**

Lease areas of Zawar comprise five hills, namely Mochia Magra, Balaria, Zawar Mala, Baroi and Bawa. At present underground work is being carried out at Mochia and Balaria, and surface explorations are in progress in the other three areas.

4.4 Mochia mine, which is still under development, is the largest Pb-Zn mine in the country. Production is taking place in the first seven levels and development of level 8 is in progress. A shaft 310 metres in depth has been sunk and is fitted with a hoist gear to raise about 4,000 tonnes per day (TPD). During the Fourth Plan period it is proposed to develop the mine to a capacity of 2,000 TPD. **Mochia**

4.5 The Balaria hill when fully developed will sustain a production of 500 TPD. The Balaria hill is rich in zinc ore and pyrites with very little lead content. **Balaria**

4.6 Employment at Zawar has registered a steady increase after the taking over of the mining operations by HZL in 1965. There is a 50% increase at Mochia and a 300% increase at Balaria in 1971 in comparison to the peronnel employed by the MCI in 1965. **Employment**

Table 4.1 : Personnel Strength—Zawar Group

	22.10.1965	31.1.1971
Exploration	26	90
Mochia Mine Level		
1 to 4	671	553
5 to 7	—	360
8	—	24
Balaria	87	321

Source : Hindustan Zinc Limited.

4.7 Accidents at the Zawar Mines have been very few (4 fatal) since 1965. The accidents have been due to negligence on the part of the workers. Slipping and falling, collapse of a concentrate heap, etc. are the major causes for these accidents. Safety conciousness is imparted to the workers through safety training courses. **Safety**

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5. Production Trend and Grade Structure

5.1. Run-of-mine ore from Zawar has been steadily increasing with the development of different levels in Mochia and Balaria mines. An analysis of the total production for the last ten years shows an increasing trend except during 1965-66 when HZL took over from MCI after the latter had stopped further mine development due to financial difficulties (Table 5.1). However there has been a steep increase since 1965-66, when the production was 145 thousand tonnes against 271 thousand tonnes in 1970-71.

Table 5.1 : Production at Zawar during 1961-62 to 1970-71

(In tonnes)

Year	ROM	Pb concentrate	Zn concentrate
1961-62	146,453	5,216	9,047
1962-63	157,334	7,358	11,031
1963-64	153,876	5,147	9,900
1964-65	162,550	6,296	10,880
1965-66	145,063	5,057	8,909
1966-67	154,344	5,242	9,548
1967-68	170,994	3,765	11,204
1968-69	191,498	3,462	12,532
1969-70	225,203	3,600	14,356
1970-71	271,006	3,594	15,978

Source : Hindustan Zinc Limited.

5.2. It might be observed (Table 5.1) that even though the production of zinc concentrate has increased by 66% since 1966-67, production of lead concentrate has decreased by 50%. The Zawar Group has Pb-Zn of 3.5-4% metal content with a predominance of zinc. Lead occurs as a co-product along with zinc. The Mochia mine contributes about 60-65% of the total production and Balaria about 35-40%. Both the mines have registered a steady increase since 1965-66 and it is expected that by the end of the Fourth Plan, the Mochia mine will be producing 2000 TPD of ore and the Balaria mine 500 TPD.

6. Processing of Pb-Zn Ore

6.1 Processing of the Pb-Zn ore from Zawar is essential before it can be put to any use. Concentrating, smelting and refining are the steps to be followed to obtain pure metal.

6.2 Ore dressing plants to concentrate the ore are located at the mine site. Three mills are in operation to beneficiate the ore. By the process of differential flotation, zinc and lead concentrates are separated. Metal recovery is stated to

be 92% for lead and 86% for zinc. The product assays about 73% Pb and 55% Zn in their respective concentrates. Besides lead and zinc small amounts of silver and cadmium are recoverable and sulphur is obtained as a by-product (Table 6.1).

Table 6.1 : Constituents of Lead and Zinc Concentrates

Product	Lead concentrate	Zinc concentrate
Silver oz/tonne	25.30	5.6
Lead	74.0 %	0.9%
Zinc	6.5 %	54.5%
Cadmium	—	0.23%
Sulphur	16.0 %	32.0%

Source : IBM—Base Metals of India Bulletin No. 1.

6.3 Zinc concentrates received from the mines are processed at the zinc smelter plant at Debari. The zinc unit comprises :

(i) Fluo solid roaster of 120 tonne/day capacity

(ii) Sulphuric Acid plant with capacity of 90 tonne/day of 98.5% concentration **Debari**

(iii) Super Phosphate (16-18% P_2O_5) plant of 240 tonne/day capacity

(iv) Cadmium refinery of 200 kgs/day

Zinc concentrate is charged into a roaster to convert zinc sulphide into zinc oxide. This zinc oxide is dissolved in by-product sulphuric acid and after purification and electrolysis yields zinc metal in the form of cathode sheets. These sheets are melted in a low frequency induction furnace and cast into ingots.

Table 6.2 : Products of Zinc Smelter

Product	Purity	Rated Capacity (Tonnes)	Production in 1970-71 (Tonnes)	% of Capacity
Zinc Ingots	99.95%	18,000	10,735	60.0
Cadmium Ingots	98.95%	72	22.68	30.0
Super Phosphate	16-18%	78,000	51,504	66.0
Sulphuric Acid	98.5 %	29,000	21,196	68.0

Source : Hindustan Zinc Limited.

Cominco Binani Zinc Limited

6.4 *Cominco Binani Zinc Limited.* The Cominco Binani zinc smelter at Alwaye, Kerala is based on imported concentrates and has a capacity to produce 20,000 tonnes of zinc metal. Due to teething troubles the plant could not reach rated capacity even though the plant was commissioned in January 1967. Production is getting stablised and during 1970-71 an output of over 14,000 tonnes of zinc metal was anticipated as against 13,800 tonnes during the previous year.

6.5 Hindustan Zinc Limited is the primary producer of lead in the country, The lead smelter at Tundoo (Bihar) comprises :

(i) Sintering plant of 70 tonne/day capacity

(ii) Two blast furnaces of 20-30 tonne/day and 25-35 tonne/day capacity

(iii) Silver refinery of 3,600 kg/year capacity. Silver is obtained as a by-product.

Table 6.3 : Products of Lead Smelter

Product	Purity	Rated capacity (Tonnes)	Production in 1970-71 (Tonnes)	% of Capacity
Lead	99.99%	5,400	1,719	32
Silver	996 fines	3.6	2,302	67

Source : Hindustan Zinc Limited.

It has been reported that modernisation of the lead smelter at Tundoo is necessary as the smelter has become obselete and does not permit recovery of useful traces of valuable metals in the lead concentrate other than silver. The rated capacity is 5,400 tonnes of lead metal ; actual production has been in the range of 2,000 tonnes per annum. The reduced production is due to the low lead content of the ore mined in the Zawar area. In view of the large gap between the rated capacity and supply, substantial efforts are called for in increasing the indigenous production of lead concentrates. A Fourth Plan allocation of Rs. 7.5 million has been made for the modernisation of the lead smelter at Tundoo, which will make it possible to obtain other by-products from the lead concentrate.

7. Cost and Price Structure

7.1 The mining cost in the Zawar mines (Rs. 27.63/tonne) compares favourably with the mining costs in the USA ($ 3.75/tonne). Cost of mining depends upon the extent of over burden, method of mining, richness of deposit and volume of production. Even though the mining costs in India and the US are comparable, the cost of production of the metal in India is four to five times that in the USA because of the poor metal content of the ore.

High Concentrate & Power Costs

7.2 Mining forms the major component of the cost of producing a tonne of either zinc or lead concentrate (Table 7.1). Depreciation, royalty and overheads constitute about 40% of the total cost. Table 7.2 indicates that the concentrate cost

is about 62% and 67% of the total cost for zinc and lead respectively. Power and fuel cost is 10%. HZL has in the past been paying a very high rate, viz. 9.5 paise per unit, for power, which seriously affected the cost. Zinc produced by electrolytic method is power intensive and power should be treated as a raw material. The HZL has sought reduction in the electricity tariff.

Table 7.1 : Cost of Zinc and Lead Concentrates (1970-71)

(Rupees)

Element of cost	Cost of ore	Cost/tonne of zinc concentrate	Cost/tonne of lead concentrate	% Share
Mining	27.13	373.86	488.60	41.13
Milling	13.15	176.99	231.31	19.47
Adn. and Other	8.42	113.93	148.90	12.53
Overhead	12.42	165.62	216.45	18.22
Depreciation & Royalty	5.81	78.61	102.74	8.65
Total	67.25	909.01	1,188.00	100.00

Note : Costs have been allocated between zinc concentrate and lead concentrate in the ratio of their metal content.

Source : ORG Mineral Survey.

Table 7.2 : Cost of Zinc and Lead Metal (1970-71)

(Rupees)

Element of cost	Zinc		Lead	
	Cost/Tonne	% Share	Cost/Tonne	% Share
1. (i) Concentrate	2,364	61.77	2,600	67.06
(ii) Other material	395	10.32	361	9.31
(iii) Power and fuel	390	10.19	59	1.52
2. Fixed cost	420	10.98	1,148	29.61
3. Depreciation and Interest	887	23.18	405	10.45
4. Less credit for by-product sales	629	16.44	696	17.95
Total cost	3,827	100.00	3,877	100.00

Source : ORG Mineral Survey.

7.3 The average selling price of lead during 1969-70 was Rs. 2,550/ tonne and that of zinc in 1970-71 Rs. 2,850/ tonne. Comparison of the average selling price with the average cost of production (Table 7.2) indicates a loss of Rs. 1,327/ tonne and Rs. 923/tonne for lead and zinc respectively. This high loss per

Loss per tonne of Lead & Zinc sold

tonne can be attributed to the apportioning of cost for depreciation of about Rs. 1,300/tonne and Rs. 1,000/tonne for zinc and lead respectively. High depreciation cost is because of the large capital structure in the form of machinery for mining, concentration and refining, infra-structure facilities etc. The unit costs of production of lead and zinc, which are directly affected by the cost of concentrate production, depreciation etc., will be reduced with the increase of mine output from the existing 800 TPD to the targeted 2000 TPD and full utilisation of the lead and zinc smelters, which are operating below rated capacity (Tables 6.2 & 6.3). During the year 1970-71 the Debari smelter operated at about 39% of its rated capacity and the Tundoo smelter at about 69% of its rated capacity.

8. Marketing and Transportation

Imports of Lead and Lead Alloys

8.1 The internal demand for lead and zinc far surpasses the production in the country. India imports substantial quantities of zinc, lead and their alloys every year (Table 8.1). Australia is the largest supplier (60-65%) of pig lead to India, followed by Canada, Mexico and the USA, the principal producers of lead. Antimonial lead and lead alloys are imported from the UK and Australia. The USSR, the UK and Australia are the principal suppliers of worked lead in the form of pipes, sheets, plates etc. There has been a steady demand for pig lead and lead alloys in the country. Since 1966 there has been a steady decline in the imports of lead, with the decrease being about Rs. 5 million each year. The fall in imports is attributed to the substituting of lead by PVC for sheathing of power cables. Use of PVC sheathing in place of lead has been enforced for cables rated at up to 1.1 KV with effect from 1967-68, and is being extended to cables of higher voltages up to 11 KV. The change-over will depend upon the pace at which indigenous manufacturers install the necessary plant and equipment. It is expected that the change-over will result in a saving of approximately Rs. 80 million per year in the import of lead.

Imports of Zinc and Zinc Alloys

8.2 Imports of zinc have been quite erratic since 1965. Imports of concentrates started in 1967 and has registered an increase with the utilisation of imported concentrates by indigenous smelters. Imports of zinc spelter and zinc alloys registered a very sharp fall, to Rs. 65 million, in 1969 compared to the imports in 1968, which amounted to Rs. 213 million. A material balance prepared by the Sub Group II of the Planning Group has estimated an import of 80 thousand tonnes in 1969 with an average growth rate of 10%. Considering this estimate of demand it could be seen (Table 8.1) that the import in 1968 was far in excess of the requirements for that year and it could well have met a part of the 1969 requirements, and hence the sharp fall in the 1969 imports.

8.3 Zinc concentrates were being exported to Japan until 1965, but there have been no exports of concentrates since the commissioning of the two smelters in the country. Australia and Canada are the principal suppliers of zinc alloys to the country. The USA, Australia and Canada are the major exporters of worked

zinc, in the form of pipes, plates, rods etc., to India. All out efforts were made in 1965 to conserve non-ferrous virgin metals and canalise them for important industrial uses. In October 1965, the Scarce Industrial Materials Control Order was promulgated and all the available stocks of copper, zinc, lead etc., covered by the order were canalised for meeting the needs of priority indentors. The Scarce Industrial Materials Control Order was withdrawn in June 1966, consequent to devaluation and liberalisation in the import policy for priority industries.

8.4 Indigenous production of zinc from Debari and Alwaye and lead from Tundoo is consumed by the domestic market. Cadmium which is obtained as a by-product was exported to the UK in 1968-69. It is expected that the exports of cadmium will continue, as the estimated domestic demand in 1973-74 is 95 tonnes as against the expected production, by that year, of 260 tonnes per year.

8.5 Concentrates to Debari and Tundoo are transported by road and rail. It has been reported that there is a shortage of wagons, particularly for concentrate transported to Tundoo (Bihar) from Zawar.

Table 8.1 : Imports of Zinc during 1965-69

(Quantity in thouand tonnes)
(Value in million Rs.)

Year	Total		Zinc Conc.		Zinc & Zinc Alloys		Scarp	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
1965	91.1	148.2	—	—	90.9	145.4	1.2	2.8
1966	37.9	77.3	—	—	37.1	74.9	0.8	2.4
1967	94.9	182.2	20.6	12.7	71.4	159.6	2.9	9.9
1968	126.1	230.1	19.4	12.1	105.0	213.1	1.7	5.9
1969	60.9	91.1	30.0	20.3	29.1	65.1	1.8	5.7

Source : IBM—Mineral Statistics of India, October 1970.

Table 8.2: Imports of Lead during 1965-69

(Quantity in thousand tonnes)
(Value in million Rs.)

Year	Total		Lead conc.		Lead Alloys	
	Qty.	Value	Qty.	Value	Qty.	Value
1965	38.0	63.2	—	—	38.0	62.2
1966	38.1	76.8	—	0.1	38.1	76.7
1967	41.1	72.5	—	0.1	41.1	72.4
1968	35.2	67.2	—	—	35.2	67.2
1969	30.2	63.2	0.1	0.2	30.1	63.0

Source : IBM—Mineral Statistics of India, October 1970.

9. Future Prospects

9.1 The demand for lead and zinc will continue to have a steady increase with the industrial development of the country. The Sub-Group of Planning Group of Non-Ferrous Metals has estimated the internal requirement of lead and zinc for the Fourth Plan (1969-74). As per the estimates of the Group, demand is expected to go up from 96 thousand tonnes to 142 thousand tonnes for zinc and from 80 thousand tonnes to 97 thousand tonnes for lead. (Tables 9.1, 9.2)

Table 9.1 : Estimated Demand and Availability (Zinc)

(In tonnes)

Year	Estimated Demand	Estimated Production	Short-fall
1971-72	117,100	38,000	79,100
1972-73	128,900	38,000	90,900
1973-74	142,000	76,000	66,000

Source : Sub-Group II, Planning Group of Non-Ferrous Metals.

Table 9.2 : Estimated Demand and Availability (Lead)

(In tonnes)

Year	Estimated Demand	Estimated Production	Short-fall
1971-72	80,520	3,000	77,520
1972-73	88,580	3,000	85,580
1973-74	97,430	5,400	92,030

Source : Sub Group II, Planning Group of Non-Ferrous Metals.

9.2 There are at present two smelters for zinc, with capacities of 18 and 20 thousand tonnes. It has been reported that there is a built in potential to double the smelter capacity (to 36,000 tonnes) at HZL by adding some balancing equipment. At Alwaye, Cominco Binani have plans of expanding their present capacity of 20,000 tonnes to 60,000 tonnes in two stages of 20,000 tonnes. It is expected that by the end of the Fourth Plan the country's production would be about 76,000 tonnes.

9.3 *Vishakhapatnam Zinc Smelter.* The question of establishing a new 30,000 tonnes per annum zinc smelter based on imported zinc concentrates at Vishakhapatnam in the public sector has been under consideration of the Government. M/s. Centrozap of Poland had earlier been commissioned to prepare a project

report. The report was received in September 1970 and the approval for implementing the project was accorded in January 1971 with an initial plan allocation of Rs. 100 million.

The cost of the new project is estimated at Rs. 214.4 million, with a foreign exchange component of Rs. 14.5 million. Steps have been initiated by HZL to make arrangements for long term supply of zinc concentrates from foreign sources. The plant will be capable of making use of the sludge arising in the existing zinc smelters in the country, which contains about 16% zinc. The scheme will lead to an annual foreign exchange saving of Rs. 38 to 41 million.

9.4 As mentioned earlier (6.1) the Tundoo smelter, though having a rated capacity of 5,400 tonnes/year has been producing only about 2,000 tonnes/year. To augment the production from Tundoo, import of concentrate is being considered. However, with the development of the mines in the Rajpura-Dariba region and in Agnigundla, which are primarily lead deposits, the dependence on imports is likely to be reduced considerably.

Table 9.3 : Development Programme

(Value in million Rs.)

S. No.	Activity	Estimate
1	For the development of Mochia mine for production of 2,000 TPD. This will include construction of Tidi Dam and installation of 2,000 T ore beneficiation plant.	94.1
2	Prospecting and exploratory mining in the Pb-Zn deposits in leasehold areas of Zawar Mines.	20.2
3	Doubling the capacity of the existing zinc smelter at Debari from 18.000 to 36,000 tonne/yr.	50.0
4	Development of new mine in Zawar area for production of additional 2,000 TPD.	95.0
5	Modernisation of Lead Smelter Plant at Tundoo	7.5
6	Erection of a smelter of 30,000 tonne/yr at Vishakhapatnam	214.4
7	Development of rock phosphate mine in Maton	5.0
	Total	486,2

Source : ORG Mineral Survey.

9.5 The discovery and proving of sizable reserves of Pb-Zn in Zawar (probable reserves have been reported to be about 136 MT), Ambamata (6 MT of 8—10% Pb-Zn) and Agnigundala (12 MT of 6.5% Pb) have greatly improved the prospects for self sufficiency in lead-zinc.

Steps in the right direction have already been initiated by the HZL and the Gujarat Mineral Development Corporation (GMDC). Development of the Zawar mines is under way and is targeted to sustain a production of 4,000 TPD of Pb-Zn ore by the end of the Fourth Plan. The target appears attainable, but will demand well organised effort, as mine development is an operation which is capital intensive and requires speedy technological decisions. The GMDC is at present engaged in developing the Ambamata Pb-Zn deposit. Work has yet to start in Agnigundala. It is expected that the indigenous sources would be meeting about 70-80% of the country's requirement with the development of the Zawar group of mines, Ambamata and Agnigundala.

However, to decrease the dependence on import and brighten the prospect of self sufficiency, it is necessary to accelerate the development of the mines in areas where substantial ore deposits have been proved, namely Zawar, Ambamata and Agnigundala and also encourage more detailed and intensive exploration in these and new areas. It is also essential that studies be conducted for the possible substitution of these metals by indigenously available material in various applications.

It is encouraging to note that with a view to acclerating the exploration and exploitation of the Pb-Zn deposits and to study the feasibility of establishing new smelters of the Imperial smelter type the Central Government has proposed to take the assistance of competent consulting firms of international repute. Action has already been initiated by HZL to invite offers for technical assistance. These offers, when received, are to be evaluated by HZL so as to determine the agency from which assistance could be taken.

CHAPTER VII—COPPER

1. Introduction

1.1 As in the case of the other base metals, the copper industry in India is most seriously under-developed. Despite a sizable and sustained growth in the demand for the metal in the country—the demand is expected to increase from 98,000 tonnes in 1969-70 to 128,000 tonnes by 1973-74—the annual indigenous production of copper has remained virtually stagnant over the last decade at around the 9,500 tonnes mark. Due to the very large gap between production and demand, India continues to rely heavily on imports, which amounted to Rs. 474 million in 1969-70—an increase of over 20% over the previous year. Of the value of production of all minerals in India, copper accounts for a mere 0.9%, and only 4.5% of the value of non-fuel minerals.

1.2 At the present time, India's production of copper represents less than 0.2% of the world total. The USA, the USSR, Zambia, Chile and Canada are the largest producers of copper, and in 1968, together accounted for over 70% of the total world production. India imports copper from several sources including Zambia, the USA, the Congo, Canada, the UK, West Germany and Tanzania.

2. Brief Review of the World Copper Industry

2.1 Copper is fairly widely distributed throughout the world and almost every country has some copper deposit. There are, however, several regions containing very large deposits of the ore, which account for the bulk of the total world production.

World Reserves

2.2 Although commercial deposits of copper ores occur in every continent, it is estimated that 90% of the world's known reserves lie in five regions :

(i) The Rocky Mountain and Great Basin area of the USA.

(ii) The western slopes of the Andes in Chile and Peru.

(iii) South and Central Africa : Republic of the Congo, Rhodesia and Zambia.

(iv) The pre-cambrian shield area of Canada and its extension into northern Michigan.

(v) Kazakhstan in the USSR.

Country - wise Distribution of Reserves

2.3 It is difficult to quantify the world copper reserves chiefly because many of the large deposits are yet to be fully explored and also, it is difficult to define the 'grade limit' for economic workability in the future.

The greatest known reserve of copper ore in one body is the deposit at Chuquicamata, Chile. Most recently, copper deposits totalling 300 million tonnes (MT) of ore, of 1% metal content, have been found at Pelambres in Northern Chile. The probable reserves of this deposit are of the order of 900 MT.

Of the major producing areas of the world, the prophyry copper deposits account for the greatest tonnage of metal and one of the largest deposits of the 'porphyry coppers' in the world is located in Utah, USA.

World Production

2.4 The total world production of copper registered an increase of about 15% over the five-year period 1965 to 1969. As against an output of 5.05 MT in 1965, the total world production in 1969 is estimated to have been about 5.8 MT.

Country - wise Production

The USA is by far the largest producer of copper in the world, and in 1969 its output of 1.42 MT represented over 24% of the world total. Besides the USA, the other major producers of copper are the USSR, Zambia, Chile, Canada and the Republic of Kinshasa (Congo).

Table 2.1 : World Production of Copper Ore (Cu Content)

(In thousand tonnes)

Country	Production					% share (1968)
	1965	1966	1967	1968	1969	
World Total	5,050	5,270	5,020	5,390	NA	100.0
USA	1,226	1,296	866	1,093	1,424	20.3
USSR	700	750	800	800	850	14.9
Zambia	696	623	663	685	731	12.7
Chile	590	661	664	667	695	12.4
Canada	461	459	556	562	465	10.4
Congo (Republic of Kinshasa)	289	317	321	326	358	6.0
Peru	199	176	181	194	190	3.6
South Africa	60	117	127	128	127	2.4
Japan	107	112	118	120	121	2.2
Australia	92	111	92	109	133	2.0
India	10	10	10	10	10	0.2
Other Countries	620	638	622	696	NA	12.9

NA—Not available

Source : UN, Statistical Year Book, 1969.

In 1968, these six major producers together accounted for over 76% of the total world output. India's production of 10,000 tonnes is, in comparison, negligibly small and represents an insignificant 0.2% of the world total.

Over the five-year period ending in 1969, the production of copper increased by an impressive 23.9% in the Congo, 21.4% in the USSR, 17.8% in Chile and 16% in the USA. Among the lesser producers, there was an increase of 111.7%

in South Africa and 44.6% in Australia. India's production of copper at a meagre 10,000 tonnes annually, remained virtually stagnant over the same period.

2.5 In 1968, the world demand for copper was of the order of 7.3 MT, out of which the USA alone, with a demand of 1.5 MT, accounted for 21%. It is estimated that the world demand for copper by the end of this century will be in the region of 32 MT, which represents an annual growth in demand of over 4.8%.

World Demand

2.6 In 1965-66 India's demand for copper was 58,000 tonnes. It is estimated (Ministry of Steel and Mines, Report of Sub-Grpup II, 1968) that by the end of the Fourth Five Year Plan, this demand will rise to 128,000 tonnes, representing a yearly growth rate of 10.4%.

India's Demand

2.7 The low level of indigenous production and the sustained growth in demand in the country have made India rely heavily on imports. In 1967-68, imports of copper amounted to Rs. 360 million (Table 2.2) and by 1969-70, this figure had increased to Rs. 478 million—representing a yearly increase of over 15%. At the present time sizable imports of copper constitute a substantial drain on the country's foreign exchange reserves.

Import Dependence

Table 2.2: Indian Imports of Copper*—By Sources of Supply

(In million/Rs.)

Country	1967-68	1968-69	1969-70	% share 1969-70
World Total	359.52	395.54	478.08	100.0
Zambia	24.68	80.12	200.98	42.0
USA	55.79	128.76	103.25	21.7
Congo (Rep.)	—	2.02	55.72	11.6
Canada	27.71	19.36	45.86	9.6
UK	60.64	32.54	27.81	5.8
W. Germany	95.95	68.98	21.27	4.4
Congo (Braz.)	30.63	25.06	7.76	1.6
Tanzania	0.26	1.17	2.75	0.6
Belgium	36.98	22.17	1.30	0.3
Other Countries	26.88	15.36	11.38	2.4

*Primary metal, Copper alloys & Scrap.

Source: Monthly Statistics of Foreign Trade, Government of India.

3. Geology and Copper Reserves in India

Copper bearing minerals have been reported from almost every State in India but the important and commercial deposits are confined to a few mineral-rich districts in Bihar, Rajasthan and Madhya Pradesh. These ore deposits occur both in ancient crystallines as well as in several of the younger rock groups, while the copper ore of the other States of India is found in highly metamorphosed rocks. The individual lodes consist of one or more veins of solid sulphide, varying considerably in thickness, the average being only 5 to 7 inches. On either side of this, the sheared country rock is partially replaced by sulphides to a variable width.

India's Resources

3.1 The total probable reserves of copper ore in India are estimated to be of the order of 366 MT of 1% Cu content. The Singhbhum belt in Bihar, with estimated reserves of 175 MT of 1% Cu, accounts for nearly 48% of the total reserves. The Khetri and Kho-Dariba belts in Rajasthan, on the basis of the explorations carried out so far, contain 126 MT of ore.

A comparatively recent find in Malanjkand in Madhya Pradesh has proven reserves of 25 MT of 0.9% Cu with probable reserves of a further 25 MT. The reserves in Andhra Pradesh, comprising of the deposits in the Agnigundala and Mailaram belts, account for 3.3% of the total reserves in India (Table 3.1). Comparatively smaller, yet commercially workable, deposits of copper ore have been located in Gujarat, Mysore and Himachal Pradesh.

Bihar

3.2 Bihar has the largest proven reserves of copper ore in India, totalling 175 MT of 1% Cu content and represents over 48% of the total reserves. The most important deposits are located in the Singhbhum belt comprising of the Rakha group of mines, with estimated reserves of 63.9 MT of 1.5% Cu content, Tama

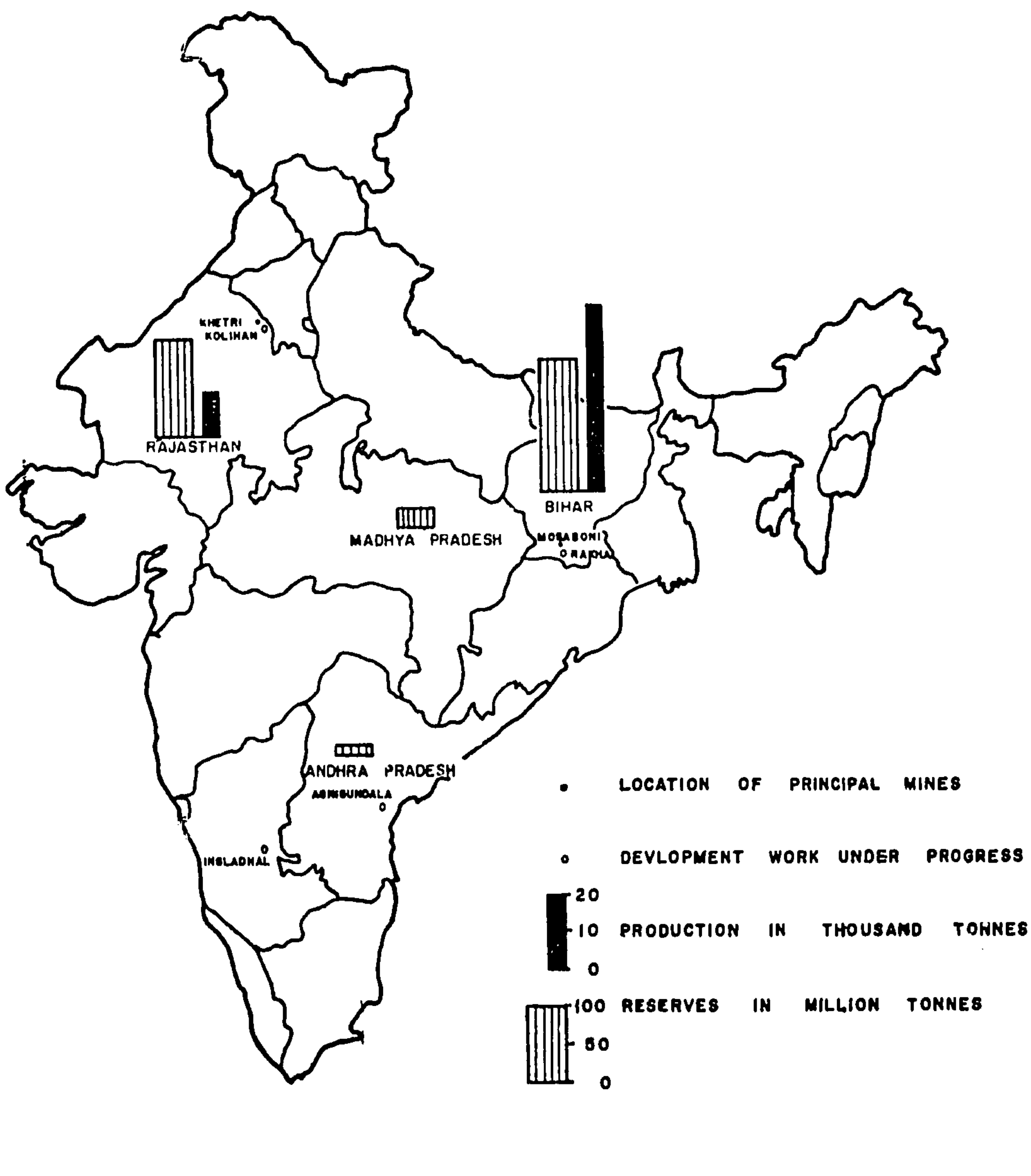
Table 3.1 : Reserve of Copper Ore*

State	Reserves in million tonnes	% share
All India	366.06	100.0
Bihar	175.01	47.8
Rajasthan	126.30	34.5
Madhya Pradesh	45.00	12.3
Andhra Pradesh	12.19	3.3
Gujarat	6.00	1.7
Mysore	1.56	0.4

* Standardised at 1% Cu content

Sources : (1) Estimates Committee Report—1969-70. GSI.
(2) Department of Mines & Geology, Rajasthan.
(3) Indian Copper Corporation.
(4) Hindustan Copper Limited.

LOCATION OF PRINCIPAL COPPER MINES, RESERVES & PRODUCTION BY STATES, 1970



Pahar and Turamdih with combined reserves of 28 MT of 1.49% Cu and the Mosaboni group of mines with 4 MT of 2.27% Cu. It is most probable that substantial reserves are yet to be proved in the latter region. A large deposit of 9.7 MT of 1.49% Cu has also been proved at Nandup.

Mineralisation in this region has been observed to follow the sheared zones, of which the main zone, on which the present copper mines are situated, stretches for a distance of 130 km from Chakradharpur to Sungri. The ores in the Singhbhum belt occur as veins and lodes in the granite and in the neighbouring mica and quartz schists and epidiorites. The veins are best developed along a zone of overthrust where they form well defined lodes as in the case of the Rakha and Mosaboni mines.

3.3 The copper ore reserves in Rajasthan are the second largest in India. Of the total 126.3 MT of 1% Cu reserves of the State, the Khetri belt—comprising of Madan Khudan and Kolihan—alone accounts for over 95%. Smaller but nevertheless commercially workable ore deposits have also been located in the Kho-Dariba belt and Pur-Dariba. Other potential areas within the region are being geologically investigated to locate further deposits of the ore. **Rajasthan**

Mineralisation in the Khetri belt is found to follow shear zones, a number of which are present in the region.

3.4 Comparatively recently a substantial prophyry copper deposit has been located at Malanjkand, about 65 km north of Balaghat. On the basis of the geological investigations carried out so far, reserves of 25 MT of 0.9% Cu content have been proved and possible reserves of the ore would be about 25 MT. **Madhya Pradesh**

The copper minerals in the upper portion of the deposit are oxides and are sulphides in the lower levels.

3.5 Andhra Pradesh, with proven copper reserves of 12.2 MT of 1% Cu, accounts for 3.3% of India's total reserves and ranks fourth in the State-wise classification. The more important deposits have been located in the Agnigundala and Mailaram belts and the largest of these is in Nallakonda, where 3.2 MT of ore of 1.82% Cu content has been proved. **Andhra Pradesh**

In the Agnigundala belt, copper mineralisation has been found to extend over a distance of 3 km. There are 3 principal areas of ore deposit. In the first area, the lode extends over a length of 900 m, while in the second area, several narrow ore shoots, up to 3 m wide and 90 to 150 m in length, with dissemination of chalcopyrite and occasionally of galena and zinc blende, have been found. In the third area, a mineralised zone, ranging from 1.5 to 3 m in width with 5 ore shoots of a total strike length of about 680 m, has been traced.

3.6 In the Ambamata-Dariba region, on the border of Rajasthan and Gujarat, reserves of 6 MT of 9.8% lead-zinc and 1% copper have been proved, and it is **Gujarat**

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likely that probable reserves would be even greater. At present further geological investigations, to define mineralised zones both laterally and at greater depths are in progress. The other States, which account for less than 1% of the country's copper reserves are Mysore, Himachal Pradesh, West Bengal and Assam. Exploratory investigations are in progress to locate the potential areas and assess probable reserves.

4. Structure of the Copper Mining Industry in India

Nature of Ownership

4.1 Of the 7 operating copper mines in India, at the end of 1970, only the 3 mines in Bihar, owned by the Indian Copper Corporation (ICC), a private sector enterprise, were sufficiently developed to be productive. The once productive Rakha group of mines, also in Bihar, though developed up to the 9th level, were closed down early in 1924, and remained so for over 40 years. It was not until 1967 that this group of mines was taken over by the newly formed public sector undertaking, Hindustan Copper Ltd. (HCL).

The entire responsibility for the development of the 'Khetri Copper Complex', in Rajasthan, once vested with National Mineral Development Corporation (NMDC), was transferred to HCL in 1967. The remaining mine at Ingladahl, in Mysore, a comparatively small working, is owned by the Chitradurga Copper Company. Hence of the 7 mines, 3 are in the public sector and the remaining 4 are in the private sector.

4.2 All the copper mines in India are underground mines and the productive mines are fully mechanised.

Type of Working

The 3 mines of the Mosaboni group, being worked by ICC, are all within one consolidated lease area of 7,000 hectares. The company is negotiating for a further lease area of 1,722 hectares.

There are two lodes of copper in the Mosaboni area : (1) The main lode (2) The western lode, which run parallel to each other. At the surface, the lodes have an inclination of 38° which decreases with depth to 25°.

Mosaboni Group

At the Mosaboni mine, the largest of the group, a depth of 1,088 metres has been reached. There are 8 vertical shafts in use at the mine besides 2 sub-inclines, pilot shaft, winzes etc. In the Surda mine, 3 vertical and one inclined shafts and in Pathargora, the smallest of the group, one vertical shaft are in use. All the ore from the drives, rises, winzes and stopes is brought in underground tubs, hauled by electric battery operated locomotives on selected levels, from the working faces to the plat, where the ore is tipped in ore-bins and is hauled up in the shaft skips to the surface. At the Mosaboni mine the r.o.m. ore is fed directly to the crushing and screening plant whereas the ore from Pathargora and Surda have to be transported by trucks, distances of 1 mile and 3 miles respectively.

The ore from the crushing plant is then transported a distance of 6 miles by aerial ropeway to the Company's concentrator and flash-smelter units.

The two mines of the Khetri group in Rajasthan

A. Madhan Kudhan

B. Kolihan

are in the process of being developed by HCL. The ground level of the Madhan Kudhan lease area is 350 metres above sea level (zero level). HCL is, at present, progressively developing levels below ground level and simultaneously driving into the hill. The service shaft has already been sunk to zero level, its ultimate depth, and the production shaft, which will be sunk to a depth of 430 metres below ground level, has already reached a depth of 390 metres. A crushing and screening plant is to be installed at the base of the production shaft and ore will be fed to the plant by means of ore passes.

The two shafts are to be linked by drives at zero, 180, 240 and 300 metre levels. Production will first commence at the 180 m level and levels above it. Full production of 8,000 tonnes per day from this mine is expected to be achieved by 1978.

The development of Kolihan will be synchronised with that of Madhan Kudhan and it is expected to produce its rated capacity of 1,600 tonnes per day by 1978 as well. A process plant, comprising of a concentrator, a smelter and an electrolytic refinery, is being installed at Khetri. The smelter is scheduled to go on line in 1973-74.

Rakha Group

Since the Rakha mines were shutdown for such a long period, substantial amount of work is involved in de-watering and further developing the mines to make them productive. Furthermore, it was reported by HCL that the geology at Rakha is considerably different from those either at Mosaboni or at Khetri. Mineralised zones at Rakha contain, besides copper, workable deposits of tungsten and tin. In order to effectively exploit all the minerals, HCL is at present seeking foreign technical collaboration for its mining activities at Rakha.

Ingladahl Mine

This comparatively small mine is still in the early stages of development. Geological investigations to prove workable reserves are in progress simultaneously with mine development.

Employment

4.3 The scale of operation in Indian copper mines varies considerably as outlined in 4.2. The average daily employment in ICC's Mosaboni group of mines exceeds 5,000 whereas that of Ingladahl mine is only about 110 (Table 4.1).

Table 4.1 : Distribution of Copper Mines by Employment Groups (All India, 1968)

Employment Group	No. of Mines
51— 150	2
151— 250	1
251— 400	1
401— 500	—
501— 800	1
801—1,200	1
1,201—1,600	—
1,601 and above	1
Total	7

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

Both HCL as well as ICC employ all mine personnel directly as opposed to contractual labour. As and when the mines of HCL are brought to full production, radical changes in the mine employment profile will automatically result. It was reported by ICC that whereas there is no dearth of unskilled mine labour, technical and skilled personnel were not readily available.

Safety

4.4 Since all the copper mines in India are underground mines and are also mechanised, the number of accidents, though largely of a minor kind, is quite high. At the Mosaboni group of mines, with daily employment of 5,593, of the 1,146 accidents reported in 1970, 89.3% were minor, 9.5% caused serious injuries and 1.2% proved fatal.

5. Production Trend and Grade Structure

5.1 Except for a mine in Bihar, belonging to ICC, which closed down in 1967 because of exhausted reserves, there has been no change in the number of copper mining units in India (Table 5.1), over the three year period 1968 to 1970.

Table 5.1 : Number of Copper Mines—All India & Major States 1967-70

State	1967	1968	1969	1970
Bihar	4	3	3	3
Mysore	1	1	1	1
Rajasthan	3	3	3	3
All India	8	7	7	7

Source : (i) DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1967, 1968.
(ii) IBM—Mineral Statistics of India 1969, 1970.

5.2 In 1970, the total production of copper ore in India amounted to 518 thousand tonnes as against 448 thousand tonnes in 1960, which represents a yearly increase of less than 1.5%. Throughout, the production of ore has been virtually restricted to the Mosaboni group of mines in Bihar and it was not until 1966, that there was a meagre output of 3.2 thousand tonnes from the Madhan Kudhan mine in Rajasthan (Table 5.2). **Production**

This latter production of ore in effect represents only the ore recovered in the process of the development of the Khetri group of mines. However, experimental production of ore from the upper levels of Madhan Kudhan was started in July 1970 and this reflected in a comparatively larger output of 12.2 thousand tonnes in 1970. Regular production, at the limited scale of 3,000 tonnes of ore per day, is scheduled to start at Madhan Kudhan from July, 1972.

A negligibly small quantity of ore, only about 100 tonnes per annum, is being recovered since 1969, again in the process of development, from the single mine in Mysore.

In 1970, the production of ICC mines amounted to 506 thousand tonnes as against 448 thousand tonnes in 1960, representing a yearly increase of a meagre 1.2%. However, over the recent years, ICC had to level off ore production due to the capacity restrictions of the company's flash smelter.

5.3 The average grade of the ore mined by ICC is about 2.0% Cu content but since 100% of ore production is beneficiated by the company, ore gradation is of little significance. However, the limit of payability for mining by ICC is a minimum lode width of 40 inches averaging 1.8% Cu content. **Grade**

Table 5.2 : Production of Copper Ore (R.O.M.) during 1961-70
All India and States

(In thousand tonnes)

Year	All India	Bihar	Rajasthan	Mysore
1961	423.3	423.3	—	—
1962	492.2	492.2	—	—
1963	474.4	474.4	—	—
1964	473.0	473.0	—	—
1965	467.6	467.6	—	—
1966	484.0	480.8	3.2	—
1967	469.6	459.0	10.6	—
1968	483.6	475.7	7.9	—
1969	510.5	509.3	1.1	0.1
1970	518.3	506.0	12.2	0.1

Source : IBM—Mineral Statistics of India, January 1971.

6. Processing of Copper Ore

Need for Beneficiation

6.1 The commercial production of copper in India is mainly by pyrometall -gical methods (smelting) followed by electrolytic refining or recovery. As metallic copper forms only a very small percentage of the r.o.m. ore, it is considerably more economical to first beneficiate the ore to concentrate the mineral prior to smelting.

Present Practice

6.2 ICC, the only commercial copper producing unit in India has its own ore processing plant at Ghatsila in Bihar.

At the mine head at Mosaboni the ore is crushed and fed by means of a chain feeder on to a grizzly with 3 inch aperture, the oversize being sent back to the crusher. The undersize from the grizzly is passed over Gyrex vibrating screens with 3/8 inch screens. The oversize from the screens is passed over a moving belt where waste rock is removed by hand picking. The sorted ore is taken to a Symon's Cone Crusher. The crushed product and the undersize from the screens are taken on a belt conveyor to the ropeway storage bins. The ore is then fed to buckets and conveyed a distance of about 9.5 km over a mono-cable aerial ropeway to the concentration mill storage bins at Moubhandar.

In the concentration mill the ore is first ground in ball mills to 200 mesh size. It is then taken to froth floatation cells where over 97% of the copper is recovered in a concentrate carrying approximately 26% of metal. The reagents used consist of pine oil as frother and potassium ethyl xanthate as collector for the copper ore. The concentrates are allowed to flow by gravity to a Dorr Thickener and then filtered and dried. The product is then charged into a reverberatory smelting furnace which produces a matte carrying about 42% copper. When it is desired to speed up smelting, the concentrates, before being put into the reverberatory furance, are roasted in a Herreshoff type furnace connected with a Buell Micro Lector dust separator. The roasted ore improves the production capacity of the reverberatory furnace as also the quality of the matte. The matte is treated in converters where the sulphur and iron are removed leaving a low grade or "blister" copper, which then passes to a refining furnace for the production of refined copper in ingot form assaying about 99.5% copper and graded as "Best Select".

7: Cost and Price Structure

Costs

7.1 ICC was not prepared to disclose any quantitative operating cost data to the Study Team and so, no cost analysis could be presented.

Cost Estimates of Public Sector Undertaking

7.2 It was been estimated (NMDC—Planning Division Report) that the capital cost per tonne of copper, for a project similar to that at Khetri, would be of the order of Rs. 22,000. This cost covers the whole complex including mining, concentrating, smelting and refining facilities, the township, watersupply, power

lines and other facilities. Also in the cost, depreciation at 5% and interest charges at 7% have been provided for. From this report, an estimate of the operating costs is shown in Table 7.1.

Table 7.1 : Estimated Costs of Copper Production

Element of Cost	Cost per tonne (Rs.)	% Share
Mining, Transportation and Overheads	3,500.00	52.7
Milling	1,100.00	16.6
Concentrating	1,540.00	23.2
Refining	500.00	7.5
Total	6,640.00	100.0

Source : ORG Mineral Survey.

7.3 The Indian Government fixes ceilings on selling prices of the various grades of copper. Since India is substantially import dependent, current world market prices for copper are reflected in the Indian market prices. **Price Structure**

8. Marketing and Transportation

8.1 The demand for copper in India far exceeds domestic production. The level of production in 1969-70 barely met 10%, of the demand. The sizable indigenous supply deficit, which is increasing yearly by 11.2% (Table 8.1), is being alleviated to some extent by imports, which represented over 47% of the total demand in 1969-70. Despite the substantial imports, which increased yearly by 9.3%, over 42% of the demand could not be met in 1969-70. The net supply deficit increased by 13.4% each year over the period. **Copper Market in India**

8.2 Because of the strategic nature of the metal, the Government keeps strict control over the distribution of both the indigenously produced and imported copper. Hence the open market in copper is mostly confined to copper scrap. **Government Control**

8.3 At the present time, all imports of copper are channelled through the MMTC. India imports metallic copper, alloys as well as copper scrap. Zambia is the largest exporter of copper to India, accounting for 42% of total imports in 1969-70. The USA, the Congo, Canada, the UK, West Germany, Tanzania and Belgium are the other major sources of supply of copper for India. **MMTC and Copper Imports**

8.4 Transportation, as far as the Indian copper industry is concerned, poses no serious problems. The link roads connecting the Mosaboni group of mines are fair and plyable throughout the year. Ore from the crushing plant at Mosaboni is transported by aerial ropeway to the processing plant at Moubhandar.

Transportation

The Khetri complex also, when fully developed, should have no transportation problems.

Table 8.1 : India's demand and Supply of Copper

(In thousand tonnes)

	1967-68	1968-69	1969-70
Demand	80,134	88,468	97,669
Production	9,255	9,253	9,806
Indigenous supply deficit	71,079	79,215	87,863
Imports	38,936	43,023	46,522
Net supply deficit	32,143	36,192	41,341

Source : 1. Monthly Statistics of Foreign Trade, Government of India.
2. Ministry of Steel, Mines and Metals, Report of Sub-Group II, (Non-Ferrous Metals), 1968.

9. Future Prospects

Nearly 40% of the world output of copper is from developing countries and yet, India, with estimated reserves of 366 MT, accounts for less than 0.2%. It is apparent that the copper industry in India is most seriously under-developed and that a concerted and altogether result-oriented effort, both in terms of effective exploitation of proven reserves as well as further geological investigations, needs to be urgently made if the country is to become less import dependent.

Development of Existing Projects

9.1 *ICC*: The company's present expansion programme, comprising the installation of a new flash smelter of 16,500 tonnes per annum capacity, is likely to be completed by the end of 1971. However, production of copper is expected to increase to only about 13,000 tonnes due to the capacity restrictions of the company's present beneficiation plant and non-availability of the anticipated copper concentrates, equivalent to 3,800 tonnes of copper metal, from public sector sources. The company is, therefore, considering various proposals for further development of copper mines and also for installing additional concentration facilities, to achieve the rated capacity possibly by 1973-74.

9.2 The entire Khetri complex, being developed by HCL, at an estimated total cost of Rs. 960 million will be based on the two mines : Madhan Kudhan and Kolihan. The processing plant, consisting of a concentrator, flash smelter and electrolytic refinery, is scheduled to be installed by 1973-74. Production of ore, on a limited scale of 3,000 tonnes per day, is to start from the upper levels of Madhan Kudhan by July 1972. Full production of ore at 8,000 tonnes per day for Madhan Kudhan and 1,600 tonnes per day for Kolihan is scheduled for 1978. This is to sustain a targetted annual production of 31,000 tonnes of electrolytic grade copper.

Khetri Complex

9.3 A scheme for the phase I development of the Rakha group of mines for the production of 1,000 tonnes of ore per day equivalent to an annual output of 3,500 tonnes of copper is under implementation by HCL. Simultaneously, a scheme for the sull scale exploitation of the Rakha reserves for a production of 20,000 tonnes of copper per annum is also being developed.

Rakha

9.4 Provided the existing projects are successfully executed on schedule, the installed capacity of copper production in India in the 1980's would be in the region of 70,000 tonnes per annum (Table 9.1).

Copper Production in 1980's

Table 9.1 : Installed Capacity of Copper Production in 1980's

(In tonnes)

Mosaboni Group	16,500
Khetri	31,000
Ambamata Dariba	2,500
Rakha Group	20,000
Total	70,000

Source : ORG Mineral Survey.

9.5 Estimated demand for copper, at the present rate of growth of demand, would be of the order of 240,000 tonnes by 1980-81. On the basis of these estimates, over 70% of the demand for copper in the country would not be met by indigenous production. With India's limited resources of foreign exchange, such a huge supply gap cannot be met by imports alone. A more positive approach would be to further increase production capacity.

9.6 The result of preliminary exploratory work at Malanjkand have been very encouraging. These investigations have confirmed the initial observation that an open cast copper mine could be developed with a relatively short gestation period and low capital cost. Malanjkand with these special features could be easily developed into a very productive region. This could be considered as a short term arrangement to meet the immediate requirement till the bigger and more productive mines are developed.

Malanjkand

CHAPTER VIII—MICA

1. Introduction

1.1 India is the world's largest producer of muscovite ruby mica of excellent quality and meets about 80% of the world's requirement of sheet mica. In India, mica occupies eleventh position among the minerals produced in the country. In terms of value, mica constitutes only 0.4% of the total mineral production of the country. The mica industry in India is almost entirely export oriented. Domestic consumption of mica and mica products is estimated to be not more than Rs. 10 million compared to the total exports of about Rs. 175 million in 1969-70. Mica exports constituted 11.5% of mineral exports and 1.2% of total exports of the country during the same year. Mica exported from India is predominantly natural mica (about 90%). The rest is fabricated and manufactured mica.

Export Oriented Industry

2. Brief Review of World Mica Industry

2.1 The USA is, at present, the largest producer of mica when all classes of mica are taken into consideration, but the USA raises only a small quantity of high quality sheet mica. In the USA many deposits have been worked for scrap mica only. Argentina is another important mica producer, though its output is also largely of the lower qualities classified as block stained. Africa has emerged as a source of considerable importance since the Second World War. The mica produced in Angola and Tanzania is of excellent quality preferred for some of the most exacting uses but quantitatively the output is very small compared to those of India and Brazil. Canada was an important producer of phlogopite until the lower cost deposits of the Malagasy Republic were opened and since then there has been only intermittent production of muscovite mica. Almost all the world requirement of phlogopite is met by the Malagasy Republic but the output is only a fraction of that of India or Brazil since there is hardly any use of mica where phlogopite is preferred to muscovite.

World Production

Total annual production of all classes of mica in the world has been around 150 thousand tonnes since 1964 (Table 2.1). 93.5% of the total world production in 1968 was scrap mica and the remaining 6.5% was high quality sheet mica. The USA is the largest producer of mica, accounting for 74.2% of the total produce. However, as already mentioned, almost all of it is scrap; better quality mica forms a negligible quantity. India's production of all kinds of mica forms 14.5% of the total world production. India produces 9.3% of scrap and 5.2% of better quality sheet mica, thereby becoming the largest producer of sheet mica. India's production dropped from 20.4% of world production in 1964 to 14.5% in 1968. The fall in production was both in scrap and in better quality mica. South Africa ranks third with a production of 5.3% of the total. Almost the entire production of South Africa is scrap mica. The production has shown an increasing trend, the increase being from 2.2% in 1964 to 5.3% in 1968. Brazil, the Malagasy Republic and Norway are the

other major producers of mica. Brazil's production has heen steadily declining, falling from 1% in 1964 to 0.66% in 1968. Production of the Malagasy Republic has shown a slight increase but the production is mainly scrap mica along with some better quality sheet mica. Norway's production is 2.9% of the total production and is only waste mica.

Table 2.1 : World Production of Mica—Total and by Major Countries—1964-68

(Quantity in thousand tonnes)

Country/Item	1964	1965	1966	1967	1968
World Total	146.5	156.9	146.9	144.0	153.0
USA	104.3	109.5	102.7	107.6	113.8
Sheet	0.1	0.3	—	—	—
Scrap	104.2	109.2	102.7	107.6	113.8
India	29.9	37.6	33.0	21.2	22.2
Blocks	1.9	1.4	1.7	1.6	1.7
Splittings	8.8	9.4	6.4	5.5	6.2
Scrap	19.2	26.7	24.9	14.0	14.3
Brazil	1.5	1.4	1.0	1.0	1.0
Malagasy Republic	0.7	0.6	0.7	0.7	0.9
Blocks	0.1	0.1	0.1	—	0.1
Splittings	0.6	0.5	0.6	0.7	0.8
S. Africa	3.1	2.3	2.2	4.6	7.9
Sheet	—	—	—	—	—
Scrap	3.1	2.3	2.2	4.6	7.9
Norway (Scrap)	4.0	3.0	3.0	4.5	4.5

Source : Minerals Year Book, Vol. I. Bureau of Mines, US Department of the Interior, 1968.

2.2 The major exporting countries of the world are India, the USA, West Germany, France, the UK, Brazil and the Malagasy Republic. India is the foremost supplier of muscovite mica in the world, with an export of $ 25 million during 1969. India's exports are mainly natural mica in the form of blocks, splittings and condenser films. Brazil and the Malagasy Republic are her immediate competitors. Exports of major selected countries during 1965-69 are shown in Table 2.2. **World Exports**

Table 2.2 : Export of Mica from Selected Major Countries—1965-69

(Quantity in thousand tonnes)
(Value in million US $)

Country	1965		1966		1967		1968		1969	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
India*	43.4	25.4	18.8	21.3	23.0	21.6	20.9	20.6	24.3	23.3
USA	3.8	2.2	5.1	2.5	6.7	2.5	12.4	2.8	5.6	3.1
UK	2.9	1.3	2.5	1.1	0.8	0.7	0.6	0.7	NA	NA
France	NA	NA	1.0	1.1	1.2	1.6	1.9	1.6	NA	NA
West Germany	0.6	0.7	0.8	0.7	0.8	0.8	0.9	0.9	NA	NA

*Exports of India relate to the accounting year April to March.
NA—Not available

Source : Annual Statements of Export and Import of the Respective Countries, 1965 to 1969.

Exports of the USA have been steadily increasing, from $ 2.2 million in 1965 to $ 3.1 million in 1969. Exports of manufactured mica constitute 61% of the total exports, the remaining being natural mica (including ground mica). Canada has been the major importing country, its share increasing from 20.8% of the total exports of the USA in 1965 to 33.0% in 1969. The other major importers are Mexico and Italy accounting for 9% and 10% respectively.

Brazil has been a major supplier of natural mica to the USA with an export of $ 1 million in 1968. The exports of Brazil, however, to the USA have decreased from $ 2.27 million in 1966 to $ 1 million in 1968. Brazil's exports of manufactured mica is negligible. Brazil's exports to France and West Germany are also quite small.

The Malagasy Republic's principal buyer has been the USA. The exports to the USA have decreased from $ 0.34 million in 1966 to $ 0.19 million in 1968.

The UK's exports have declined from $ 1.3 million in 1965 to $ 0.7 million in 1968. The principal buyers were West Germany and France with imports of $ 0.1 and 0.09 million respectively in 1968. Export of worked mica formed 89% of the total exports of the UK during 1968.

Exports of West Germany have shown a steady increase from $ 0.75 million in 1965 to $ 0.86 million in 1968. Its major markets are the EEC countries and Switzerland.

2.3 The major importing countries of the world are the USA, Japan, the UK, West Germany and France. Imports of the USA have shown a steady decline

from $ 6 million in 1965 to $ 5 million in 1968. The principal exporting countries are India, Brazil and the Malagasy Republic. India's exports accounted for 64% of the total USA imports and those of Brazil and the Malagasy Republic 20% and 3% respectively for the year 1968. The imports are mainly natural mica.

Imports of Japan showed an increasing trend, from $ 3.0 million in 1965 to $ 4.4 million in 1968. The principal exporters were India (72%) and Malagasy (15%) during 1968. Blocks and splittings are the major varieties imported by Japan from India.

Imports of the UK have been mainly from India. India's exports to the UK were mostly blocks ($ 1 million), films, splittings ($ 1.3 million), mica waste and others ($ 1.2 million) and mica manufacturers ($ 0.3 million) in 1968. The total imports were $ 4.6 million. France was the other major supplier.

World Imports

West German imports were $ 3 million in 1968. The major exporters were India (35%) and other countries of the EEC (25%). Imports from India were mainly scrap mica. Imports from the EEC were mostly plates and strips and manufactured mica products. Imports by major selected countries during 1965-68 are shown below (Table 2.3).

Table 2.3 : Import of Mica by Selected Major Countries—1965-68

(Quantity in thousand tonnes)
(Value in million US $)

Country	1965		1966		1967		1968	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
W. Germany	7.0	3.3	6.8	2.5	6.7	2.3	11.9	3.1
Japan	6.6	3.0	4.5	3.3	7.6	4.7	18.3	4.4
UK	13.8	5.3	9.8	4.1	9.0	3.6	13.3	4.6
France	—	—	7.6	1.9	4.0	2.5	5.2	1.7
USA	NA	NA	6.1	10.7	3.6	5.4	4.5	5.0

NA—Not available

Source : Annual Statements of Export and Import of the Respective Countries, 1965 to 1968.

2.4 Mica consuming countries have been making considerable efforts to develop substitutes having some of the properties of mica. Need has been felt in industrially advanced countries for the substitution of imported natural mica as the costs of processing crude mica and preparation of mica sheets are very high. Good deal of manual labour is involved in splitting and processing mica, making the preparation of sheet mica very uneconomical in the USA and the West European countries. In addition, importing countries are also concerned about their dependence for this strategic material on foreign countries.

Growth of Mica Substitute

Various materials have been used as replacements for mica. Resin impregnated paper, silk, vulcanized fibres, polyester films, bakelite and asbestos laminated sheets, and fibre glass mica have been used in place of mica paper or mica linen in low potential electrical equipment etc. Polyester film is emerging as the strongest competitor of micanite sheets. The advantages of using polyester film are that (i) it can be used as wrapper and can withstand high temperature (ii) it can be made uniform in thickness and (iii) it can be made available in any thickness.

Reconstituted Mica

Reconstituted mica is one of the most successful efforts in the direction of mica substitution, Reconstituted mica is prepared by converting scrap mica into pulp which in turn is converted into coherent sheets, by employing the process of conventional paper making. Samica, a particular brand of reconstituted mica, is now being partly used for manufacturing mica plates, mica tapes, mica tubes and mica washers, all of which were hitherto prepared exclusively from mica spittings.

Synthetic Mica

Synthetic mica was first commercially produced in 1965 in the USA by the Integrated Mica Corporation and the Synthetic Mica Corporation.

Bulk of synthetic mica crystals is consolidated to yield (1) glass bonded mica, (2) reconstituted mica, and (3) hot pressed insulating refractory with good electrical and mechanical properties. Hot pressed mica is a new engineering material. Glass bonded mica is a heat resistant material with consistent electrical properties. Reconstituted sheet mica permits higher operating temperatures in electronic applications.

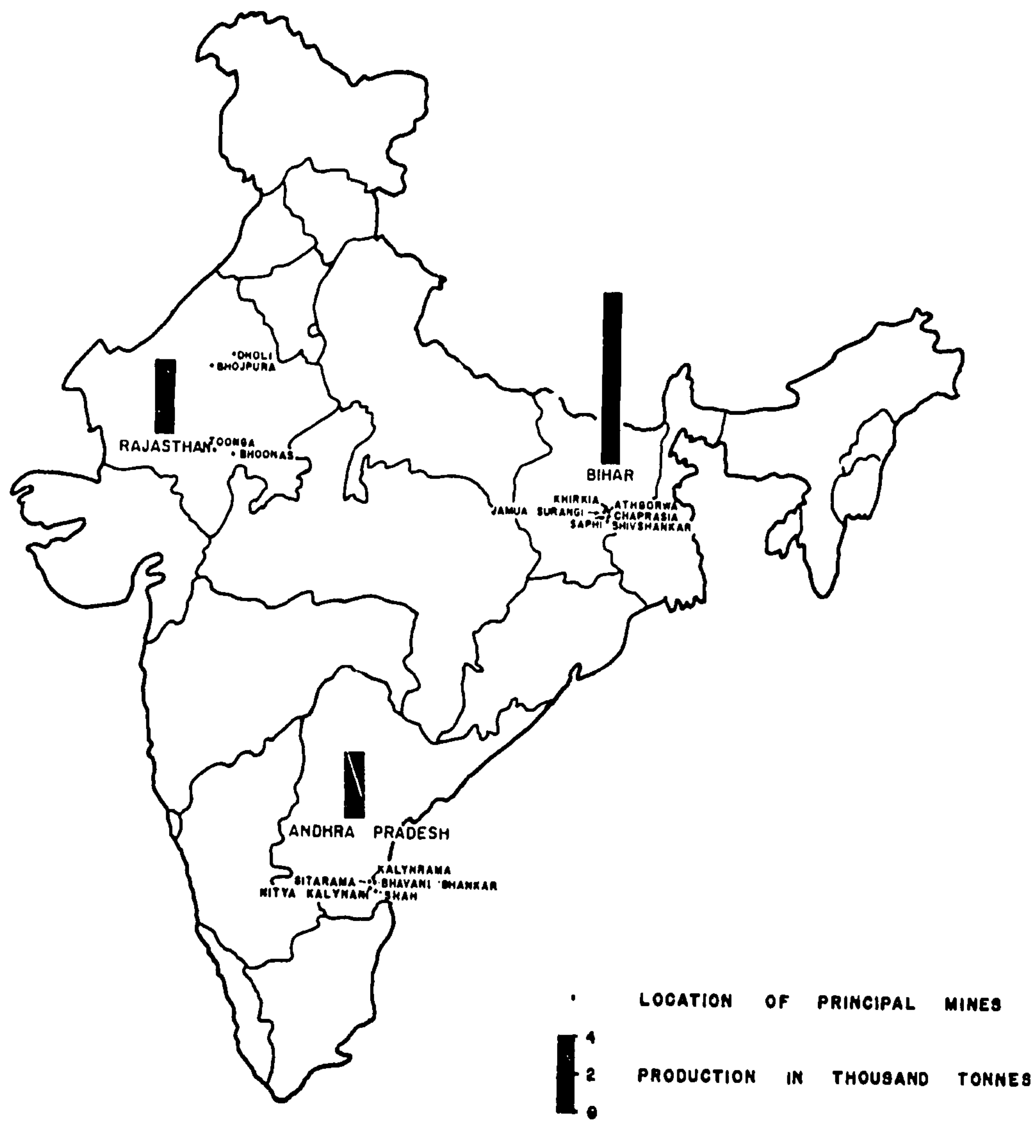
Despite experimentation over a long period of time no effective substitute for muscovite mica in the important applications has yet been found. Every now and then claims are being made that synthetic mica having properties comparable to those of natural muscovite mica is being developed but the impact of it has not yet been felt. The properties and performance of natural mica, at present, are admittedly superior. Besides, with the exception of reconstituted mica and a few other substitutes, the technology for most of the alternattve products is not sufficiently advanced for large scale production.

3. Mica Reserves in India

Problems of Estimation of Mica Reserves

3.1 Because of the highly erratic character of occurrence of mica in the pegmatites, conventional drilling methods are applicable to a very limited extent in the estimation of reserves of mica. Drilling can only indicate the existence of mica and cannot predict anything about the extent and richness of deposits in the pegmatites. The existence and extent of pegmatites is normally ascertained by surface mapping. In cases where the pegmatites are covered by overburden and are not exposed to the surface, geophysical tests are applied to locate them.

LOCATION OF PRINCIPAL MICA MINES, AND PRODUCTION BY STATES, 1970



3.2 Surface mapping done by the Geological Survey of India indicate the existence of mica bearing pegmatites in different areas in the States of Andhra Pradesh, Bihar, Gujarat, Kerala, Madhya Pradesh, Tamil Nadu, Maharashtra, Mysore, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal. Current production of crude mica comes almost exclusively from Andhra Pradesh, Bihar and Rajasthan. Till now, the pegmatites in other States have not been fully explored and worked. Again, the mines in Andhra Pradesh, Bihar and Rajasthan are at present worked only up to a certain depth (beyond which operation becomes uneconomical with the present level of mechanisation). But, there is no evidence to say that mica does not occur at further depths. Thirdly, the problems of reserves arise, normally, when deposits are confined to a few selected regions. But, in case of mica, the deposits spread over vast stretches of granite and other crystal rocks. All this indicates that Andhra Pradesh, Bihar, Rajasthan and other States possess enough deposits of muscovite mica—almost inexhaustible in the foreseeable future—at the present rate of mining of crude mica. **Mica Reserves in India**

3.3 In Andhra Pradesh, mica belts are concentrated in the Nellore District. The Nellore deposits extend over an area about 100 kilometres long and about 15 kilometres wide. The majority of the mines are located along two approximately parallel lines on the eastern and western sides of the belt. Major part of production of Andhra Pradesh is green muscovite mica. **Andhra Pradesh**

Mica belts in Bihar stretch over an area about 145 kilometres long and about 25 kilometres wide. The centres of activity are Kodarma Reserve Forest, Chatkari, Domchanch, Gawar and Tisri and Hazaribagh district. Most of the mica mined in Bihar is of ruby variety and of high commercial quality. **Bihar**

Rajasthan mica occurs in a belt stretching over an area about 360 kilometres long and about 100 kilometres wide. Mica mining in Rajasthan is concentrated in Tunka, Gundli, Nathi ki keri and other areas in the district of Bhilwara. Other major mica producing areas are Ajmer, Tonk and Jaipur districts. In Rajasthan, there is predominance of spotted mica. **Rajasthan**

4. Structure of Mica Mining Industry in India

4.1 Mica mining in India is almost entirely a private sector venture. The Safi mica mines are the only public sector mines, run by the Department of Mines and Geology, Government of Bihar. Total number of mines operated by Safi were four and total production was about 67 tonnes during 1969. This constituted only about 0.4% of total all India production during the same year. **Private Sector Venture**

4.2 Proprietorships and partnerships are the two common forms of ownership in the private sector in Andhra Pradesh, Bihar and Rajasthan. Proprietorship is more common. The third group of mineowners are private limited companies. In Bihar, there are a few public limited companies. Each mineowner is invariably **General Observations about the Mineowners**

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a processor because crude mica is hardly directly sold. The processing work done by the mineowners consists of dressing of crude mica by sickles and scissors (only in Andhra Pradesh) into blocks and chillahs. In Andhra Pradesh, processing also involves making of waste rounds (blocks No. 6 and below) from smaller sizes of crude mica. Processed mica is sold to exporters. The entire production of cut mica in Rajasthan is sold to exporters in Kodarma and Giridih in Bihar. In Andhra Pradesh, most of the production is sold to local exporters. None of the mineowners is an exporter, except one in Andhra Pradesh.

Capital Investment

4.3 The majority of the mineowners in Andhra Pradesh and Rajasthan fall in the class of owners of small scale industries. Except in the case of 2 units in Andhra Pradesh and 4 in Rajasthan, capital investment of the mineowners does not exceed Rs. 0.75 million, the dividing line for size classification of Indian industries. Small mineowners are less common in Bihar. In Bihar, there are 13 mineowners with capital investment of more than Rs. 0.75 million. These units together accounted for about 81% of total crude production during 1969.

Production

4.4 Measured in terms of average daily employment, production and by size of total capital investment, mica mining in India consists of a large number of small operators. Out of the total of 531 mines operating during 1969, annual production of only about 100 mines was above 50 tonnes (Table 4.1).

Table 4.1 : Distribution of Mica Mines in India by Production Groups 1969

Production (Tonnes)	No. of Mines
Less than 50	432
51—100	51
101—200	27
201—300	13
301—500	6
Above 500	2

Source : ORG Survey of Mica Mines.

Bihar, with the largest number of mines and maximum production, also claims the majority of the big mines. Rajasthan has the least number of mines with annual production above 100 tonnes. All the mines with production above 300 tonnes are located either in Bihar or in Andhra Pradesh.

Employment

4.5 As would be evident from the Table 4.2 average daily employment of about 85% of the mines do not exceed 50. There are only 68 mines out of 518 mines (about 13%) whose average daily employment ranges between 50 and 150, and only 7 mines with daily employment above 150. Majority of these mines are mechanised mines and are located in Andhra Pradesh and Bihar.

Table 4.2 : Distribution of Mica Mines in India by Average Daily Employment, 1968

Employment Group	No. of Mines
Up to 50	443
51—150	68
151—250	4
Above 250	3

Source : DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1968.

4.6 Mechanisation, in general, is more common in Andhra Pradesh and Bihar than in Rajasthan. Deepseeded mines in Andhra Pradesh and Bihar seem to make mechanisation a more profitable proposition. But, mechanisation is confined only to a few underground mines and there are a few opencast mines which are semi-mechanised. **Mechanisation**

4.7 Human risk is associated with all mining activities. Mica is no exception to this. But, compared to coal mines, incidence of deaths and accidents is less in mica mines. Comparative rates of accidents, death, and serious injury in coal, mica, iron ore and manganese ore mines in India are shown below.

Table 4.3 : Accidents in Coal, Mica, Iron ore and Manganese Mines, 1968

	Rate per 1,000 employed			
	Coal	Mica	Iron ore	Manganese Ore
Death	0.53	0.42	0.29	0.16
Serious Injury	4.68	1.02	1.42	1.52
Accidents				
Fatal	0.47	0.36	0.27	0.16
Serious	4.50	0.78	1.38	1.92

Source : Indian Labour Statistics, Labour Bureau, 1970.

For human safety, hats and boots are used in the mica mines. In the underground mines, safety lamps are also used.

5. Production Trend and Grade Structure

5.1 Mica mining in India is undergoing a long spell of steadily declining activities. All the available indicators—number of working mines, employment and production—bear evidence to this. During the five year period 1966-1970 total number **Declining Activity**

of working mines declined from 665 to 504, a decline of about 25% (Table 5.1). The decline came predominantly from the largest producing State, Bihar. Number of working mines in Bihar declined from 378 in 1966 to 262 in 1970. The reasons generally put forward by the mineowners for declining activities is the decline in the profitability of the mining operations resulting from increasing costs of production against stationary floor prices for exports.

Table 5.1 : Number of mica Mines Operating in India and Major States—1966-70

Year	All India	Andhra Pradesh	Bihar	Rajasthan
1966	665	71	378	211
1967	636	78	350	202
1968	634	65	353	208
1969	531	67	267	193
1970	504	61	262	176

Source : Indian Bureau of Mines.

5.2 Decline in the number of working mines has resulted in parallel movement in production (Table 5.2). Production of crude mica in India declined by 12,000 tonnes (42%) from 28,300 tonnes to 16,300 tonnes, between 1961 and 1970. The decline in Bihar's production was about 5,000 tonnes. Till 1969, decline in the combined production of Andhra Pradesh and Rajasthan was less steep than in Bihar. But in 1970 there was marked decline in the production of these two States.

Table 5.2 : Production of Crude Mica, all India and Major States, During 1961-70.

(In thousand tonnes)

Year	All India	Andhra Pradesh		Bihar		Rajasthan	
	Qty.	Qty.	% Share	Qty.	% Share	Qty.	% Share
1961	28.3	7.0	24.7	13.6	48.0	7.7	27.2
1962	28.5	7.0	24.6	14.0	49.0	7.4	26.0
1963	25.4	7.1	27.9	11.4	44.9	7.0	27.5
1964	22.8	6.1	26.7	11.2	49.1	5.5	24.1
1965	23.8	5.6	23.5	11.7	49.1	6.5	27.3
1966	22.9	4.4	19.9	12.7	55.4	5.8	25.3
1967	18.2	4.1	22.5	10.0	54.9	4.0	22.0
1968	18.3	5.1	27.9	9.2	50.2	3.9	21.3
1969	17.6	5.1	29.0	8.4	47.7	4.1	23.3
1970	16.3	3.8	23.3	8.9	54.6	3.4	20.8

Source : IBM—Mineral Statistics of India, January 1971.

5.3 Mica is graded according to size and quality, because value added to crude mica depends on both size and quality of sheet mica. Size of mica block varies

from a minimum of one sq. inch (No. 7) to a maximum of 48 sq. inches (No. 1). Given the same quality, the value of sheet mica increases directly with increase in size. Quality of mica varies inversely with the existence of stains and spots in sheets mica. Best quality mica is clear mica with no stains or spots. Stained mica is inferior to clear mica and spotted mica is the most inferior quality.

Grading of Mica

Of the total production of crude mica from the mines, about 70% is rejected as waste and scrap. Only about 30% is recovered as usable, blocks, films and splittings. Most of the high quality condenser films and blocks are made from Bihar ruby mica. In quality, next to Bihar ruby mica is green Andhra mica. Most of the production of Rajasthan is stained and spotted mica.

6. Processing of Mica

6.1 Crude mica obtained from mines is mixed with pegmatite materials and hence it is sent to cutting sheds for dressing. The preliminary dressing (cobbing) of crude mica is done at mine sites and trimming shops. Crude 'blocks' are freed from dirt and waste as well as from defective materials such as ruled, buckled, wrinkled, and wavy mica and only sound mica is retained. Cobbed mica is then rifted or split up into sheets of 3.175, 1.5875 or 0.7938 mm (1/8, 1/16, 1/32 inch) thickness or less. Roughly, the ratio of dressed mica obtained to crude mica as mentioned above, is about 30%. Rifted sheets are trimmed by removing defective mica around edges. Trimmed mica, also known as sheet mica, is finally processed into mica blocks, films and splittings with sickle or knife. The amount of wastage in final trimming varies from 3 to 4% of split sheets. Dressing and splitting is done at Kodarma, Giridih and Hazaribagh. The trimming mica from Rajasthan is also sent to these centres. Mica blocks and films are further processed into various fabricated parts and splittings manufactured into built-up mica and micanite products before finally used.

Dressing

7. Cost and Price Structure

7.1 The mica mining industry in India is a labour intensive industry. The cost structure of the surveyed units shows that in Andhra Pradesh the average labour output ratio (labour includes supervisory staff also) is 0.53; in Bihar 0.62; in Rajasthan 0.54. The other two major cost components are explosives and power and fuel. Cost co-efficients of the mica mining industry in Andhra Pradesh, Bihar and Rajasthan are shown below.

Cost Co-efficient in Mica Mining

State	Total cost	Labour	Super-visory Staff	Power and Fuel	Explo-sives	Lubri-cants	Spares and Stores
Andhra Pradesh	1.0	0.36	0.17	0.21	0.17	0.01	0.12
Bihar	1.0	0.62	*	0.14	0.11	0.01	0.12
Rajasthan	1.0	0.40	0.14	0.14	0.16	0.04	0.14

* Included in Labour

Source : ORG Survey of Mica Mines.

7.2 The above co-efficients are not constant co-efficients. They vary rather widely, from one mine to another. Variations in the cost co-efficients also indicate the variations in actual costs. Inter-mine fluctuations in costs are very wide. This is true of total cost as well as the major cost components. The cost data of the surveyed units show that in Andhra Pradesh total cost ranges from a minimum of Rs. 281.23 to a maximum of Rs. 1,939.50 per tonne. Wages, the most important individual component, range from Rs. 52.10 to Rs. 640.95 per tonne. Inter-mine variation in costs, to a large extent, is inherent in the nature of mica mining itself. The highly erratic character of natural occurrence of mica makes it virtually impossible to predict the richness of deposits in a particular vein. And, the costs involved are independent of whether the particular pegmatites are rich or completely barren. And, when in one case, pegmatites are continuously rich and in another, they continue to be barren, difference in unit cost will be very high. Unit mining costs of a cross-section of big and small mines in Andhra Pradesh, Bihar and Rajasthan at different production levels during 1969 are shown in Table 7.1.

Wide Variations in Unit Cost

Table 7.1 : Unit Mining Costs of Selected Mines in Andhra Pradesh, Bihar and Rajasthan and their Production Levels—1969

S. No.	Production (Tonnes)	Mining Cost Rs./Tonne
1	64.0	2,320.00
2	87.0	1,210.00
3	95.0	1,050.00
4	128.0	973.00
5	203.0	598.00
6	232.0	909.00
7	274.5	281.23
8	296.3	163.83
9	320.0	1,035.00
10	578.8	495.17

Source : ORG Survey of Mica Mines.

7.3 Alternations of rich deposits and poor deposits or barrens not only explain inter-mine variations in costs in a particular year, but also fluctuations in costs of a particular mine over the years. Cost structure of selected mines have been studied over the years. But, in each of the mines neither total unit cost nor the individual components show any steady trend, in spite of the fact that there had been definite increase in costs of major mining equipment and accessories like

No Fixed Trend in Unit Cost

rock drills, compressors, drill steel, candles and electricity (Table 7.3). Fluctuations in unit mining costs of selected mines during 1965-69 in Andhra Pradesh Bihar and Rajasthan are shown in Table 7.2.

Table 7.2 : Fluctuations in Unit Mining Cost of Mica, 1965-69

Sr. No.	Cost (Rs./Tonne)				
	1965	1966	1967	1968	1969
1	915.00	1,070.00	557.00	2,812.00	2,320.00
2	624.00	747.00	358.00	799.00	1,210.00
3	746.00	759.00	939.00	535.00	1,050.00
4	1,594.00	1,421.00	1,311.00	2,034.00	973.00
5	425.00	559.00	514.00	998.00	598.00
6	568.00	477.00	735.00	1,290.00	909.00
7	NA	558.30	551.95	448.52	472.77
8	NA	115.49	111.36	117.53	163.83
9	607.00	529.00	805.00	747.00	1,035.00
10	NA	580.70	584.50	479.92	495.17

NA—Not Available

Source : ORG Survey of Mica Mines.

7.4 But, although unit mining cost does not show any definite trend, it is evident that except in the case of explosives, there has been considerable increases in the costs of the major mining inputs. Minimum wages and prices of major mining accessories in 1960, 1966 and 1970 are shown below. **Mining Cost of Inputs**

Table 7.3 : Prices of Major Mining Accessories in 1960, 1966 and 1970.

Name of the Material	Price in 1960 Rs.	Price in 1966 Rs.	Price in 1970 Rs.	% of price increase in 1970 over 1960
Minimum Wages				
Andhra Pradesh	1.88	NA	3.00	60
Bihar	1.44	1.58	3.00	100
Rajashthan	1.12	1.31	2.31	100
Atlas Copco Drill 4 W	1,285.00	1,750.00	2,119.00	65
Atlas Copco Air Compressor VT 4	—	30,500.00	36,500.00	
Atlas Copco Drill Steels 2′ 7″	58.50	88.50	140.00	140
Atlas Copco Drill Steel 5′ 3″	68.00	107.00	159.00	116
Atlas Copco Drill Steel 3′ 11″	62.50	100.50	147.00	155
Electricity/Unit	4.96	7.50	13.00	162

Source : 1. Bihar Mica Exporters' Association, Giridhi.
2. Andhra Pradesh Mining Association, Gudur.
3. Mewar Chamber of Commerce, Bhilwara.

It would be noticed that price of drill steel (5′ 3″), a major mining input, increased from Rs. 68 in 1960 to Rs. 107 in 1966 and to Rs. 159 in 1970. Total increase during the entire period was as much as 116%.

7.5 Against increasing prices of major components of cost, the industry is faced with stationary floor prices since 1964. Till 1964, export prices of Indian mica were governed by the forces of foreign demand and supply. And, although India had virtual monopoly in the world market, keep competition among the exporters led to under-cutting of prices. To stop this anomaly, the Mica Export Promotion Council suggested to the Government of India that minimum floor prices should be introduced for different categories and qualities of mica. In February, 1964, Government of India introduced a series of floor prices for different kinds and qualities of natural mica. Fabricated and manufactured mica (except mica powder) were not brought under the purview of administered prices. The floor price (FAS) of mica scrap and waste was fixed at Rs. 0.33 per kg and for mica powder Rs. 0.36. The floor prices of major marketable sizes, and qualities of blocks, films and splittings are shown in Table 7.4.

Table 7.4 : Floor Prices (F.A.S.) of Major Marketable Sizes and Qualities Mica Blocks, Films and Splittings

	Price (Rs. / Kg)		
	Good Stained	Heavily Stained	Densely Stained
Block			
No. 5	98.00	21.78	13.31
No. 5½	71.88	14.52	7.87
No. 6	45.74	6.66	2.75
	I Quality	II Quality	III Quality
Films			
No. 5	121.0	84.70	65.34
No. 5½	96.80	64.13	50.82
No. 6	53.24	36.30	29.04
Splittings			
Book Form			
No. 5	31.46	26.62	—
No. 5½	21.78	18.15	—
No. 6	13.31	10.90	—
Loose			
No. 5	—	21.78	—
No. 5½	—	12.10	—

Source : Mica Export Policy, Ministry of Commerce, Government of India.

8. Marketing and Transportation

8.1 As mentioned in the 'Introduction' the mica industry in India is almost entirely export oriented. Domestic sales constitute only about 5% of the total turnover of the industry.

Export of mica from India did not show any perceptible increase during the last ten years. During 1960-61 to 1969-70, export of mica and mica products from India fluctuated around Rs. 175 million. Mica exported from India is predominantly natural mica (about 90%). The rest is worked mica (includes fabricated and manufactured mica). Trend in export of natural and worked mica during 1965-66 to 1969-70 is shown below.

Table 8.1 : Export of Mica and Mica Products from India, 1965-66 to 1969-70

(Quantity in thousand tonnes)
(Value in million Rs.)

Year	Total		Natural Mica *		Worked Mica **	
	Qty.	Value	Qty.	Value	Qty.	Value
1965-66	43.5	190.7	43.4	177.5	0.1	13.2
1966-67	18.8	159.5	18.7	143.1	0.1	16.4
1967-68	23.0	161.8	22.9	150.4	0.1	11.4
1968-69	21.0	155.0	20.1	134.6	0.2	20.4
1969-70	24.3	174.7	24.1	152.2	0.2	22.5

* Natural Mica includes Blocks, Films, Splittings and Waste and Scrap.
** Worked Mica includes Fabricated Mica and Built-up Mica products.
Source : Monthly Statistics of Foreign Trade, Government of India.

Natural Mica Exports

8.2 Export of natural mica declined by about 15% during the five year period 1965-66 to 1969-70. There had been significant changes in the composition and direction of trade also (Table 8.2). In 1965-66, share of Rupee Trade Areas in total mica export of India was about 30% and that of Non-Rupee Trade Areas 70% whereas in 1969-70, the respective shares were 45 and 55%. The major markets in Non-Rupee Areas are the USA, Japan, the UK, West Germany and France. Export of block mica, and films (uncut) increased but exports of splittings declined considerably.

Exports of Splittings Steadily Declining

8.3 It would be noticed that the export of splittings declined by more than 40% over the ten year period, from 91.2 million in 1960-61 to Rs. 54.4 milion in 1969-70. Both book form and loose splittings declined almost in equal proportions. India has practically lost the splittings market in the USSR and West Germany. Export to the UK has declined by about 70%. The obvious reason

Table 8.2 : Export of Blocks, Films and Splittings from India, 1965-66 to 1969-70

(Quantity in thousand tonnes)
(Value in million Rs.)
(Post Devaluation)

Year	Total		Blocks			Splittings			Films		
	Qty.	Value	Qty.	Value	% of total value	Qty.	Value	% of total value	Qty.	Value	% of total value
1965-66	10.39	163.1	1.43	58.5	34.20	8.88	97.2	59.56	0.08	10.2	6.24
1966-67	7.66	138.7	1.75	62.8	45.23	5.81	64.3	46.31	0.10	11.7	8.46
1967-68	7.59	143.0	1.56	67.6	47.23	5.95	63.9	44.69	0.08	11.5	8.08
1968-69	7.63	128.1	1.71	64.6	50.39	5.83	53.3	41.57	0.09	10.3	8.04
1969-70	8.67	144.6	1.85	75.9	52.48	6.71	54.4	37.59	0.11	14.3	9.93

Source : Monthly Statistics of Foreign Trade, Government of India.

for decline in export of splittings from India is the fall in world demand because of the growth of the reconstituted mica paper industry in the consuming countries.

The only way to avert further decline in exports of splitting and restore them to the original level is to make them available to the foreign buyers at lower prices. Aware of this, the Government of India reduced the export duty on No. 5½ and No. 6 loose splittings from 40 to 20% in March, 1969. This seems to have resulted in increase of export of loose splittings from about 5,000 tonnes in 1968-69 to about 6,000 tonnes in 1969-70. Discussion with the exporters, however, reveals that even the present price is not making splittings very attractive to foreign buyers.

Export of Mica Scrap and Waste

8.4 Mica scrap and waste does not play an important role in the mica export trade in India, because, although by quantity it constitutes about 50% of total exports, in terms of foreign exchange earnings it accounts for only about 2 to 3%. With the fixation of floor price at Rs. 330 per tonne (FAS), after devaluation in 1966, export of mica scrap and waste have almost been halved, although assessed in terms of value the decline is hardly perceptible.

Floor Price of Green and Spotted Scrap Needs Downward Revision

Promotional measures are necessary to avert further decline in exports and to clear the accumulated scrap. The fixation of same floor price for both ruby scrap and spotted and green scrap seems to have adversely affected the latter. Green and spotted scrap has always a lesser demand and more availability in the world market. And it is reported by the major exporters of mica scrap that since the increase of floor prices from Rs. 250.00 per tonne to Rs. 330.00 per tonne in 1966, export of spotted and green mica has practically stopped In view of this, it seems necessary to restore the price of green and spotted scrap to the 1964 level of Rs. 250.00 per tonne and retain the price of ruby scrap at Rs. 330.00 per tonne.

8.5 The mica fabrication industry also is almost entirely export-oriented. More than 50% of fabricated mica exports is to the USA. Export of fabricated mica from India during 1965-66 to 1969-70 is shown in Table 8.3.

Export of Fabricated Mica

Value added by fabrication is high compared to many manufacturing industries. In view of the fact that value added by fabrication is high (normally not less than 50%), one of the most important ways to increase foreign exchange earnings from mica would be to promote export of fabricated parts. There is good world demand and that India has good prospects in this is partly substantiated by steady increase in export of fabricated parts, from about Rs. 0.1 million in 1960-61 to Rs. 21.7 million in 1969-70. But, the major impediment to the development of the fabrication industry in India is the non-availability of sophisticated dies. More basically, the problem is

(i) the high cost involved in installing a self-contained tool room for manufacture of compound dies.

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Table 8.3 : Export of Fabricated Mica from India, 1965-66 to 1969-70

(Quantity in tonnes)
(Value in million Rs.)
(Post Devaluation)

Year	Total		Cut Cond. film		Washers & Discs		Sheets, Strips	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
1965-66	96.26	12.7	28.44	7.1	43.58	2.3	24.24	3.4
1966-67	133.84	15.6	33.44	8.7	78.03	3.4	22.37	3.4
1967-68	105.80	11.2	26.16	6.1	67.28	3.1	12.36	1.9
1968-69	166.13	20.0	37.97	11.6	106.37	5.3	21.79	3.2
1969-70	194.65	21.7	32.59	11.3	134.12	6.8	27.94	3.6

Source : Monthly Statistics of Foreign Trade, Government of India.

(ii) non-availability of sophisticated machine tools, components and parts including some special steel.

Solutions to these two problems warrant actions on two different lines.

Problems of Increasing Fabricated Exports

(i) So far as high cost of the die manufacturing is concerned, the Government may make liberal and expeditious grant of Customs Clearance Permits for dies and tools obtained on loan from foreign buyers to be returned with the finished products.

(ii) To solve the problem of non-availability of special components and parts, exports of fabricated mica may be classified as non-traditional export to allow import entitlements for the essential components.

9. Future Prospects

9.1 As mentioned earlier the most pertinent problem facing the mica industry in India, at present, is that of increasing cost of mining against stationary floor prices for exports. Increases in labour costs and costs of major mining accessories have been illustrated in Table 7.3 above. In addition to the increase in prices of major mining inputs, there had been considerable increases in the royalty rates on crude mica and mica scrap and waste during 1966-70. The royalty rate increased from Rs. 40 to Rs. 60 per tonne on crude mica and from Rs. 5 to Rs. 20 per tonne on mica scrap and waste. Against the above increases in costs, the floor prices for mica blocks, films, splittings and scrap and waste have not been revised ever since they were fixed in 1964. This has been clearly reflected in the decline in the number of working mines and production.

9.2 On the other hand, as mentioned in Section 8.3, splittings export has suffered a serious setback because of competition from the reconstituted mica paper industry. As already mentioned, the only way to avert further decline in export of splittings and to restore them to the original level is to make them available to the foreign buyers at lower prices. One way to achieve this, without affecting the FAS prices, will be to abolish the export duty altogether. But this may be counted only as a short-term relief to the industry.

9.3 The long-term prospect for the industry lies in the development of the fabrication activities. Because the export prices are directly negotiated with the foreign buyers on the basis of the technical specifications of the various fabricated parts and there is a large range of flexibility in the price bargains, with the development of the fabrication industry the mineowner's realisation is likely to increase. This, in turn, is likely to revive the mining activities.

Vital Role of Fabricated Mica Exports

From the point of view of increase in foreign exchange earnings also, there is a clear case for fabricated mica export, because the value added by fabrication is high and most of the exports are to free currency areas, the most important

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being the USA. Earlier, fabrication activities had been undertaken only in the consuming countries (the USA, the UK, and other continental countries). But, with increase in labour costs in those countries and the comparatively low costs in India, for many countries it becomes economical to import from India. Because mica fabricated parts are used as insulation materials in electrical and electronic industries, with the growth of these industries, one can expect a steady world demand in the future. And that India has good prospects in export of fabricated parts is evidenced by increasing exports during the last five years. But the industry can make sufficient headway only when the major impediments, as mentioned in Section 8.5, are removed.

CHAPTER IX—PYRITES (SULPHUR)

1. Introduction

India depends upon imports for its sulphur supply as the demand exceeds indigenous production. Of the total sulphur consumption in the country, about 90% is used to produce sulphuric acid for fertilizers and chemicals. Imports of sulphur in 1969-70 totalled Rs. 107 million. A small part of the sulphur requirements are met from domestic resources. The two electrolytic smelters, Cominco Binani in Kerala and Hindustan Zinc Limited in Rajasthan have a combined annual capacity of 73,800 tonnes of by-product sulphuric acid. The Madras refinery has an annual capacity of 17,700 tonnes of sulphur or 50,200 tonnes of sulphuric acid. The sulphur/pyrite mining activity in India is yet to be effectively developed. It is a comparatively new mining activity in India as production of iron pyrites for the extraction of sulphur commenced only in 1968. Sulphur accounts for only 0.2% of the total value of minerals produced in India and of non-fuel minerals a meagre 1%.

2. Brief Review of the World Sulphur Industry

2.1 Sulphur occurs in the free state in nature and is also extracted from iron and copper pyrites including concentrates from lead and zinc ores. Substantial quantities of sulphur are also recovered as by-products in the purification of coal gas and in petroleum refineries, gas plants etc.

2.2 The total world reserves of elemental sulphur and sulphur contained in pyrites and sulphides are estimated to be of the order of 560 MT (Federation of Indian Mineral Industries, Minor Minerals, January, 1970). **World Reserves**

Texas and Louisiana in the USA, Italy (chiefly Sicily), the USSR, Mexico, Chile, Japan and Spain have some of the largest deposits of naturally occuring sulphur. Smaller deposits, of minor commercial importance, are also distributed throughout the world.

2.3 The world production of sulphur increased from 25 MT in 1965 to 26.9 MT in 1967, representing an yearly growth of 2.4%. Over 78% of the total production in 1967 was in the form of mined sulpur and the remaining 5.9 MT was recovered as by-products. **World Production**

2.4 The USA is by far the largest producer of sulphur in the world and in 1967 accounted for 32.7% of the world total. Over 81% of the USA's production in 1968 was of elemental sulphur occurring in the free state. **Country-wise Production**

Besides the USA, the other major producers of sulphur are the USSR, Canada, Japan and Mexico. In 1967, these five countries accounted for over 71% of the world production (Table 2.1). Over the period 1965 to 1968, sulphur production in Canada has registered a yearly growth of 7% while that in the USA of 6.1%.

Table 2.1 : Production of Sulphur in Principal Countries

(In million tonnes)

Country	1965	1966	1967	1968	% Share (1967)
World Total	25.04	25.82	26.88	27.97*	100.0
USA	7.80	8.73	8.77	9.32	32.7
USSR	3.18	3.18	3.35	NA	12.5
Canada	2.45	2.45	2.96	3.00	11.0
Japan	2.08	2.27	2.22	2.21	8.2
Mexico	1.58	1.70	1.93	1.73	7.2
France	1.57	1.55	1.68	1.64	6.3
Spain	1.19	1.13	1.18	1.11	4.5
Italy	0.64	0.08	0.63	0.61	2.3
Finland	0.45	0.41	0.45	NA	1.7
Others	4.06	4.28	3.66	NA	13.6

*Estimated

NA—Not available

Source : Statistical Year Book 1969, UN.

India's Demand

2.5 In 1965-66, India's demand for sulphur was 490,000 tonnes, and by 1970-71 this had increased to 783,600 tonnes, representing a yearly increase in demand of 9.9%.

India's Imports

2.6 India imported 324,000 tonnes of sulphur and iron pyrites, valued at Rs. 107 million, in 1969-70. Canada, Poland, Iran and France are the major exporters of sulphur and pyrites to India (Table 2.2).

Table 2.2 : India's Imports of Sulphur and Pyrites by Sources of Supply

(In million Rs.)

Country	1967-68	1968-69	1969-70	%(1969-70)
World Total	367.42	177.25	107.04	100.0
Canada	135.02	104.93	66.01	61.7
Poland	16.92	12.56	24.40	22.8
Iran	—	—	5.84	5.4
France	11.85	3.49	5.45	5.1
USA	130.72	37.40	3.17	2.9
Qatar	—	—	1.78	1.7
Mexico	34.40	14.82	—	—
Bolivia	8.66	2.95	—	—

Source : Monthly Statistics of the Foreign Trade of India, Government of India.

3. Geology and Reserves in India

3.1 Sulphur is a comparatively scarce resource for the country. Though India does not have commercial deposits of elemental sulphur, occurrence of pyrites and pyrrhotite are fairly widespread. At the present time, India has total reserves estimated to be equivalent to about 110 MT of sulphur (Table 3.1), comprising largely of pyrites and pyrrhotite.

India's Resources

3.2 Bihar has large deposits of pyrites, totalling over 300 MT, and accounts for nearly 83% of the total reserves of sulphur in India. The bulk of the deposits, consisting of two seams, has been located at Amjhore and Kasisiyakoh. A third small seam is known to exist at Yogyamankoh.

Bihar

The pyrite seams in Bihar vary considerably in thickness, ranging from 7 cm to a metre, and the sulphur content of the deposits varies from 11.64 to 46.06%. The estimated reserves of pyrites in the Amjhore area are about 247 MT.

3.3 Comparatively recently a very large commercial deposit of pyrite—pyrrhotite, estimated at 85.54 MT of which 43.49 MT are of 25 to 30% sulphur and 42.05 MT contain 15% sulphur, has been located at Saladipura in the Sikar district of Rajasthan.

Rajasthan

3.4 Geological investigations at Ingladahl in the Chitaldurg district of Mysore have revealed several bands of pyrites ore 3 to 8 metres below the surface. This deposit has been explored by the Directorate of Mines and Geology, Mysore and a reserve of 2.03 MT, assaying 20 to 30% sulphur, has been proved.

Mysore

3.5 The elemental sulphur deposit in Puga valley, Ladakh, is the only one of its kind in the country, but due to its difficult location it is of little commercial significance at the present time. The estimated reserve of this deposit is about 203 thousand tonnes of sulphur.

Jammu & Kashmir

3.6 Pyrites associated with pyrrhotite have been located at Polur in North Arcot, and in the Nilgiris, South Arcot and Tiruchirapalli districts in Tamil Nadu. But these are minor deposits and total only 17,000 tonnes, equivalent to 3000 tonnes of sulphur.

Tamil Nadu

3.7 Occurrence of elemental sulphur has been reported from Krishna district in Andhra Pradesh. Pyrites have been found in Bilaspur, Durg and Surguja districts of Madhya Pradesh, Subansiri district of NEFA, several districts of Orissa, Ajmer, Banswara and Sikar districts of Rajasthan and several districts of U.P. and West Bengal.

Other States

4. Structure of the Sulphur Industry in India

4.1 There is only one unit in India, namely the Pyrites, Phosphates and Chemicals Limited (PPC), a public sector undertaking, mining pyrites. PPC, formerly known as Pyrites and Chemicals Development Company Limited, was formed in

Nature of Ownership

Table 3.1 : **Reserves of Sulphur in India**

State	Estimated reserves in million tonnes		% share
	Ore*	Eqvt. sulphur	
All India		111.327	100
Bihar	307.88	92.364	83.0
Rajasthan	85.54	18.250	16.4
Mysore	2.03	0.507	0.4
Jammu & Kashmir	0.203	0.203	0.2
Tamil Nadu	0.017	0.000	—

* Pyrite, Pyrrhotite and Elemental Sulphur

Source : (1) GSI.

(2) IBM—India Minerals Year Book 1966.

1960, as a subsidiary of the National Industrial Development Corporation, to exploit the pyrite deposit in India and to manufacture sulphur, sulphuric acid etc.

Nature of Deposit

4.2 The PPC pyrite mine is situated at Amjhore in Bihar. The deposit of pyrite at Amjhore occurs as a bed in the form of a gently dipping basin within the Bijaigarh carbonaceous shales of the Vindhyan formation below its contact with the upper kaimur sandstones. The bed crops out at several widely separated places along the periphery of the area.

Type of Working

4.3 Adits have been driven to reach the ore deposit and both 'board and pillar' and 'long wall' systems of underground mining are in use. Rock drills for drilling and 60% gelatine are used for blasting the holes in the ore body and working face. The roof along the 'long wall' face is supported by hydraulic steel props.

Face equipment, i.e. shuttle cars and gathering arm loaders, are being operated but these have been found to be less effective and uneconomical due to the poor roof conditions. Belt conveyors would also prove to be uneconomical as production, at the present time, is on a limited scale. Various long wall face equipment are being assessed and their relative economics evaluated.

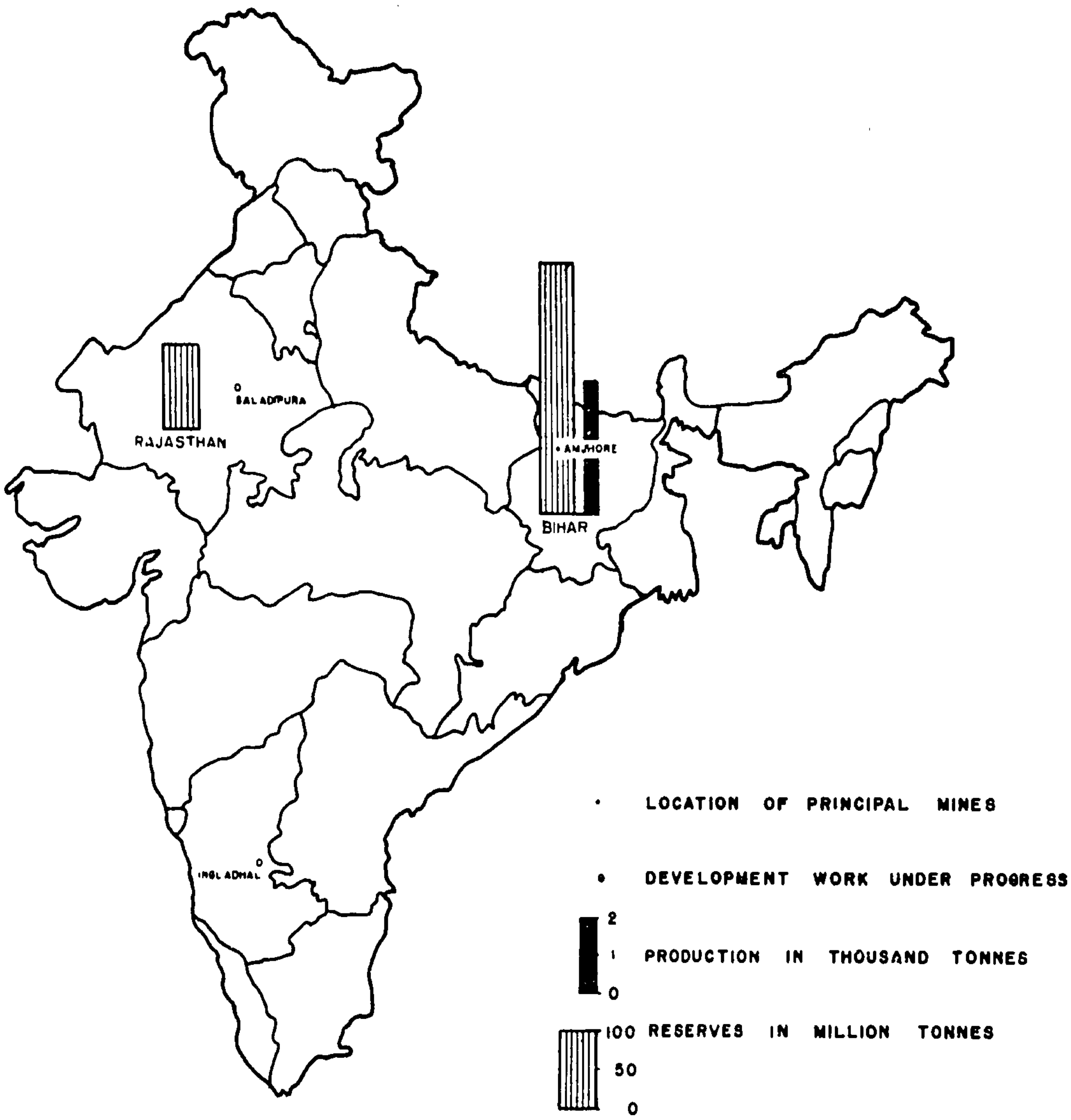
Employment

4.4 The average daily employment at the Amjhore mine is about 1700. All are permanent employees of PPC but 78% are on a daily wage basis. Daily three mine shifts and a general shift are worked.

Safety

4.5 During the four-year period 1966 to 1970, of the 47 accidents reported, 31 (66%) caused serious injuries, 12 (25%) were minor and 4 proved fatal. It was

LOCATION OF PRINCIPAL PYRITE MINES, RESERVES & PRODUCTION BY STATES, 1970



reported that all the statutory safety regulations were being observed at the mines.

5. Production Trend & Grade Structure

5.1 Pyrite mining for the extraction of sulphur is a comparatively recent development in India. PPC's Amjhore mine, the only one of its kind in India, went into production in 1968. The production of ore has been developing according to the Phase I of the mining programme, which is to achieve a production of 200 tonnes per day. Full rated production has commenced at the mine and PPC should achieve the targetted output of 60,000 tonnes in 1971-72. **Production**

The production of ore increased from only 19,310 tonnes in 1968-69 to 35,400 tonnes in 1970-71 (Table 5.1), and the equivalent production of sulphur increased from 6,565 tonnes to 12,036 tonnes.

Table 5.1 : Production of Pyrites

(In tonnes)

Year	R.O.M. Ore	Equivalent Sulphur *
1968-69	19,310	6,565
1969-70	34,354	12,069
1970-71	35,406	12,036
1971-72	60,000 **	—

* Estimated ** Targetted Production

Source : ORG Mineral Survey

At the present time, no beneficiation of the ore is done and only hand picking of waste rock is carried out.

5.2 The gradewise production of pyrites is given in Table 5.2. During the first phase of production in 1968, a small quantity—464 tonnes—of comparatively poor grade of 20—25% sulphur content was produced. At the present time PPC is attempting to stabilise production of ore at 30 to 34% sulphur content. **Grade**

Table 5.2 : Gradewise Production of Pyrites

Grade % Sulphur	1968-69	1969-70	1970-71
20 - 25%	464	—	—
33 ± 3%	8,966	24,444	35,406
40%	9,880	9,910	—
Total	19,310	35,354	35,406

Source : ORG Mineral Survey

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6. Processing of Pyrites

6.1 At the present time pyrites ore from the Amjhore mine is not beneficiated. Waste rock in the r.o.m. ore is removed by hand picking.

Need for Beneficiation

The Sindri Acid Plant of the Fertiliser Corporation of India (FCI) is the sole consumer of ore mined at Amjhore. For the present production of 200 tonnes of acid, the Sindri plant requires 230 tonnes of ore a day of 40% sulphur content. The average sulphur content of the r.o.m. ore is only 16 to 20%. Manual separation of waste rock from the ore is not very effective in improving sulphur content. Hence, there has been a drop in the average sulphur content of the ore from Amjhore. It has been reported that if the acid plant is to operate efficiently, the pyrite ore will either have to be beneficiated or imported sulphur added to it.

High Cost of Beneficiation

6.2 It has been established by the National Metallurgical Laboratory that beneficiation of the r.o.m. ore from PPC's mine could be successfully done by the heavy media separation (flotation) process. However, it has been pointed out that since the weight recovery factor is rather low and since the pyrites ore does not contain any other important mineral which could be recovered during the process, the cost of the beneficiated ore will be high. The comparative economics of beneficiation are being evaluated.

7. Cost and Price Structure

Elements of Cost

7.1 The cost of mining is dependent on the accessibility of the ore deposits, method of mining, the mineral content of the deposit and the volume of production. In the case of the Amjhore mine, the average thickness of the pyrite seam is about 20—30 cms and lies at a depth of 150 to 200 metres from the surface, with an overburden of hard rock. Underground mining methods had to be adopted. Besides, to extract such a seam of pyrite, the face to be opened is about 1.2 to 1.5 metres and the shale above and below the ore body has to be excavated. These and other factors contribute to the comparatively high cost of mining.

Mining Costs at Amjhore

7.2 The various elements of cost of mining one tonne of ore at the Amjhore mine are given in Table 7.1

Table 7.1 : Costs per Tonne of Pyrite

Cost Element	1969-70 Rs./Tonne	1970-71 Rs./Tonne	% Share (1970-71)
Total	280.88	306.20	100.0
Labour	63.19	78.06	25.5
Power	7.08	10.79	3.5
Maintenance	16.10	14.36	4.7
Explosives	6.04	4.58	1.5
Other Stores	21.98	21.44	7.0
Overheads	163.77	174.25	56.9
Royalty & Levies	2.72	2.72	0.9

Source : ORG Mineral Survey.

The total cost per tonne of ore in 1970-71 increased by 9% over that of the previous year. Costs for power, labour and overheads rose by 52.4%, 23.38% and 6.0% respectively. The overheads element of cost, nearly 57% of total costs in 1970-71, would appear to be rather high. It is likely that comparatively high rates of depreciation and interests on capital have been provided for. Cost of explosives, maintenance and stores in 1970-71 decreased by 24.2%, 10.8% and 2.5% respectively over those of the previous year.

Since PPC is the only pyrite mining unit in India no cost comparison can be presented.

Pricing Structure

7.3 The sale price of PPC's ore to FCI is still a matter of dispute. On the recommendation of the Sale Price Fixation Committee, set up by the Government, price for ore of 40% sulphur has been fixed at Rs. 260 per tonne and that of 33% sulphur at Rs. 224. These prices have not been acceptable to FCI and pending a final agreement an ad hoc price of Rs. 150 per tonne is being paid for all ore supplied to the Sindri plant. Transportation charges of Rs. 10 per tonne from the mine to Dehri-on-Sone are borne by PPC while FCI bears all other freight charges.

8. Marketing and Transportation

8.1 Demand for sulphur in India at the present time far exceeds indigenous production and the supply gap is being met to some extent by sizeable imports of sulphur and pyrites (Table 2.2). The bulk of this demand is from sulphuric acid manufacturers.

It has been estimated that the total demand for sulphur in India would be 784 thousand tonnes by 1970-71.

8.2 PPC's mine at Amjhore is a 'captive' mine, i.e. 100% of its production of ore is intended for the Sindri Acid Plant. So, the marketing of its ore poses no problem to PPC.

8.3 To meet even part of the domestic demand for sulphur India has to rely on imports. However, all imports of sulphur into the country are under the strict surveillance of the Government.

8.4 Transportation of ore poses no problem to PPC at present. The ore from the mine site is transported a distance of 32 kms by trucks to the nearest railhead, Dehri-on-Sone, on the Eastern Railway. Trucks ply over a national highway. As and when production increases to the rated capacity of 1200 tonnes per day, a rail-link between the mine and Dehri-on-Sone would greatly facilitate the transportation of the ore.

9. Future Prospects

Demand in 1973-74

9.1 The demand for sulphur increased from 490 thousand tonnes in 1965-66 to 784 thousand tonnes in 1970-71, representing a yearly growth of 9.9%. On the basis of the same rate of growth, the demand for sulphur in 1973-74 would be of the order of 1.04 million tonnes. The imports of sulphur, though on a declining trend, still amounted to over Rs. 107 million in 1969-70 and are a considerable drain on the country's foreign exchange reserves. India has substantial reserves of sulphur in the form of pyrites and a greater emphasis on effective exploitation of these reserves would help to cut down on the supply-gap in the years to come.

Role of PPC

9.2 PPC is to play a major role in the future development of the pyrite mining industry in India. The Amjhore mine has already accomplished Phase I of the mining programme, that of producing 200 tonnes of r.o.m. ore a day. Phase II of the programme is under implementation, so that by 1972-73 production will have increased to 400 tonnes per day.

The Sindri Acid Plant is scheduled to double its output and with commissioning of the Bulgarian Acid Plant of 880 tonnes a day capacity, the Amjhore mine will be required to supply pyrite ore to both the plants. So that, according to the final phase of the programme, the Amjhore mine is scheduled to produce 1,200 to 1,400 tonnes of ore a day by 1974-75.

Pyrite mining in the country is likely to take a leap forward with the development of mines at Saladipura. The discovery of sizeable deposits in this region and the reported relative ease of mining have brightened the prospects for the establishment, before the end of the decade, of a well developed pyrite mine with low mining cost. It has been reported by various study teams that the mining cost at Saladipura would be about half that at Amjhore. The productivity per man day at Saladipura is also likely to be higher than that at Amjhore. The mine at Amjhore, which is in the developmental stage, is plagued with a lot of problems due to very small width of the bed (30 inches). The width of the bed at Saladipura is reported to be more than 60 inches. Beneficiation of the Saladipura ore not only would yield substantial quantities of high grade pyrite but would also enable recovery of sizable quantities of zinc and copper.

It is necessary that the feasibility studies of the most economical and effective methods of exploiting the large reserves at Saladipura be completed at high priority, and that a time schedule for the full development of this pyrite rich region be drawn up and implemented speedily.

PART III

Legislation and Administration

CHAPTER I—DIRECT LEGISLATION ON MINING

1. Industrial Policy of the Government of India

1.1 The Government of India has enunciated its Industrial Policy, in a Resolution dated April 30, 1956, which is commonly referred to as the Industrial Policy Resolution of the Government of India.

The Government of India formulated the said Resolution in order to realise the Directive Principles of State Policy embodied in the Constitution of India, namely that it shall be the responsibility of the State in particular to direct its policy towards securing inter alia :

(a) That the ownership and control of the material resources of the community are so distributed as best to sub-serve the common good;

(b) That the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment.

The said resolution further stated that "The State will progressively assume a predominant and direct responsibility for setting up new industrial undertakings..............."

In pursuance of the National objectives to establish a Socialistic Pattern of Society, the resolution also emphasized the need for a planned, and rapid development of industries of basic and strategic importance or in the nature of public utility service which should be in the public sector.

Government further resolved that all industries which are essential, and required investment of a scale which only the State in the circumstances could provide, have also to be in public sector.

1.2 Thus the Government of India in the said resolution decided to classify all industries into three categories having regard to the part which the State could play in the development of each of them.

(a) The first category as embodied in the Schedule-A of the resolution are industries, the future development of which would be the exclusive responsibility of the State.

The First Schedule of the resolution inter alia included mining of iron, manganese, chrome, sulphur, copper and lead-zinc.

(b) The second category as embodied in the Schedule-B of the resolution constituted all industries which would be progressively State owned and in which the State would therefore generally take the initiative in establishing new undertakings, but in which private enterprise would also be expected to supplement the efforts of the State.

This frame was intentionaly left blank

The following minerals : bauxite, kyanite and mica, although not named ; have been included in Schedule-B to the resolution under the category of "other minerals".

The third category would in general be left to the initiative and enterprise of the private sector.

2. The Industries (Development and Regulation) Act, 1951

2.1 This is an Act of Parliament enacted for the express purpose of providing the Central Government with means of implementing their industrial policy resolution of 1948. The Act brought under the Central Government's control the development and regulation of a number of important industries, the activities of which affect the country as a whole and the development of which must be governed by enonomic factors of all India importance.

The Act empowered the Government to take under its control industries specified in the First Schedule upon a declaration that such taking over and control was expedient in the public interest.

The Act was to be administered by a Development Council whose prime function was to keep a watch over industrial development in India, and also to regulate the functioning of all industries mentioned in the First Schedule.

The Development Council prepares annually and transmits to the Central Government a report setting out what has been done in discharge of its function during any particular financial year.

The only mineral under survey originally included in the First Schedule was iron in metal form ; thereafter, under the Finance Act of 1964, an amendment was made to the Schedule and the following minerals were added to the list of industries specified in the First Schedule :

Iron ore	Zinc
Copper	Bauxite
Lead	Manganese

3. Constitutional Framework

3.1 Under the present Constitution of India, the legislative powers of the Union and the States have been divided into three lists, which are included in the Seventh Schedule of the Constitution. List I is the Union List, List II is the State List and List III is the Concurrent List. Lists I and II give the Union and States, respectively, exclusive powers to legislate on matters enumerated in them. As regards the development of mines and minerals the Indian Constitution gives the exclusive legislative power to the Union.

Entry 54 of List I of the Seventh Schedule :

"Regulation of mines and minerals development to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."

Entry 23 of List II of the Seventh Schedule :

"Regulation of mines and minerals development subject to the provisions of List I with respect to regulation and development under the control of the Union."

3.2 Thus it will be seen that the regulation and development of mines and minerals is wholly within the legislative jurisdiction of the Union and accordingly the Union has enacted the following Legislations :

(i) The Mines & Minerals (Development and Regulation) Act, 1957 ;

(ii) The Mineral Concession Rules, 1960 ;

(iii) The Mines Act, 1952 ;

(iv) Mineral Conservation and Development Rules, 1958 ;

(v) Mines Rules, 1955 ;

(vi) The Metalliferrous Mines Regulation, 1961 ;

(vii) The Iron Ore Mines Labour Welfare Cess Act, 1961 ;

(viii) The Iron Ore Mines Labour Welfare Cess Rules, 1963 ;

(ix) Mica Mines Labour Welfare Fund Act, 1946 ;
(Pre-Constitution Act but continued inforce by present Constitution of India)

(x) Mica Mines Welfare Fund Rules, 1948 ;
(made under the Act of 1946 above mentioned)

(xi) Mica Mines Labour Welfare Fund Establishment Contributory Provident Fund Rules, 1950.

These Central enactments govern the entire field of mineral development and the States are not authorised to legislate in this behalf. However, the States have been given authority under the Central enactments to levy royalty, octroi, transportation charges and intra-State sales tax, but nevertheless such levies must be in compliance with the above mentioned enactments.

4. The Mines and Minerals (Regulation and Development) Act, 1957

4.1 This Act has been enacted by Parliament with a two fold purpose : (a) the regulation of mines and (b) development of minerals under the control of the Union. The Act is applicable to all persons, partnerships and corporations which are involved in prospecting and mining of minerals on private or Government lands.

The Act deals with the following matters :

(a) Procedure for obtaining prospecting licences or mining leases in respect of lands in which the minerals vest in the Government.

(b) Powers to make rules for regulating the grant of prospecting licences and mining leases.

(c) Special powers of the Central Government to undertake prospecting or mining operations in certain goods.

All the minerals under survey are governed by the Act under its definition of "minerals" which includes all minerals except mineral oils and minor minerals.

4.2 The Act defines "minor minerals" to mean building stones, gravel, ordinary sand other than sand used for prescribed purposes and any other mineral which the Central Government may by notification in the official Gazette declare to be a minor mineral.

4.3 The following minerals under survey are "specified" in the First Schedule to the Act :

Chrome, Copper, Iron, Lead, Zinc,

Manganese, Sulphur.

The Act provides that no prospecting licence or mineral lease or renewal thereof shall be granted by a State Government without the previous approval of the Central Government.

As regards the minerals of bauxite, kyanite and mica which are not "specified" in the First Schedule to the Act, the Act provides that the State Government shall be authorised to issue prospecting licences and mining leases or renewals thereof without the prior approval of the Central Government but only in accordance with the provisions and requirements of this Act.

All such prospecting and mining operations are licensed under the provisions of this Act. The Act further provides power to the Central Government to make rules governing the procedure for the issuance of prospecting and mining licences and any other matters concerned therewith.

4.4 Persons eligible to make applications for prospecting licences and mining leases. The Act forbids any prospecting or mining operations in any area, except in accordance with the terms and conditions of a prospecting licence or mining lease to be issued in accordance with the provisions of this Act and any Rules made under the Act. Under the Act, all applications for prospecting licences or mining leases are to be made to, and the concessions issued by, the State Government in accordance with the provisions of this Act and its Rules.

Without the prior approval of the Central Government no prospecting licence or mining lease shall be granted by a State Government in respect of any mineral specified in the First Schedule to the Act, or to any person who is not an Indian National.

A person shall be deemed to be an Indian National :

(a) in the case of a public company as defined in the Companies Act, 1956 (I of 1956) only if a majority of the directors of the company are citizens of India and not less than 51 per cent of the share capital thereof is held by persons who are either citizens of India or companies as defined in the said Act ;

(b) in the case of a private company, as defined in the said Companies Act, only if all the members of the company are citizens of India ;

(c) in the case of a firm or other association of individuals, only if all the partners of the firm or members of the association are citizens of India; and

(d) in the case of an individual, only if he is a citizen of India.

4.5 Limits of areas for prospecting and mining operations. The Act also fixes a maximum limit to the area for which prospecting licences or mining leases may be granted to any person. In the case of prospecting licences, a maximum area of 50 sq. miles in any one State is fixed, and in the case of mining leases a maximum area of 10 sq. miles is fixed ; however power is given to the Central Government, if it is of the opinion that in the interest of mineral development and for reasons to be recorded, it is necessary to permit any person to acquire one or more prospecting licences or mining leases covering an area in excess of the aforesaid maximum.

4.6 Time periods of licences and leases. The period for which a prospecting licence may be granted is fixed as one year in the case of mica, and in the case of any other mineral two years but the prospecting licence may be renewed for one or more periods by the State Government, over periods not exceeding that for which the prospecting licence was originally granted. The period for which a mining lease may be granted shall not, in the case of iron or bauxite, exceed 30 years and in all other cases, exceed 20 years.

The mining lease may be renewed in the case of iron or bauxite for one period not exceeding 30 years and in the case of any other mineral for one period not exceeding 20 years but in the case of minerals specified in the First Schedule to the Act, the mining lease shall not be renewed by the State Government, except with the previous approval of the Central Government. Power is given to the Central Government to authorise the renewal of a mining lease for a further period or periods not exceeding in each case the period for which the mining lease was originally granted.

In respect of land in which the minerals vest in the Government of a State, the Act empowers the Central Government after consultation with the State Government to undertake prospecting or mining operations in any area not already held under any prospecting licence or mining lease. Under such circumstances the Central Government will be liable to pay prospecting fee, royalty, dead rent or surface rent as the case may be at the same rate at which it would have been payable under the Act if such prospecting or mining operations had been undertaken by any private person.

4.7 Procedure for application for prospecting licence and mining lease : Under the Act, a certain procedure has to be observed while making an application for prospecting licence or mining lease in respect of lands in which the minerals vest in the Government.

An application for a prospecting licence or mining lease in respect of any land in which the minerals vest in the Government shall be made to the State Government concerned in a prescribed form and shall be accompanied by a prescribed fee. The State Government shall acknowledge the receipt of all such applications in a prescribed form within a prescribed time as specified under the Mineral Concession Rules, 1960.

However, the State Government has the right to grant or refuse to grant such a licence or lease as long as its refusal or grant of licence or lease is made in accordance with the provisions of the Act or any rules made thereunder.

Where a prospecting licence has been granted in respect of any land, the licencee is given a preferential right for obtaining a mining lease in respect of that land to any other person who may apply for a mining lease in respect of the same land. Furthermore, where two or more persons have applied for a prospecting licence or a mining lease in respect of the same land, the person whose application was received earlier in time is given a preferential right for the grant of a licence or lease as the case may be.

Although the Act provides for preferential rights of applicants for licences and leases on the basis of first-come first-served, the Act also provides an exception to this Rule and allows the State while making such an exception to take into consideration matters relating to specialized knowledge, experience and financial resources, nature and quality of the technical staff employed or to be employed by an applicant. However, this power of the State Government is circumscribed by the requirement that where a later application is to be preferred to an earlier application, the award of a lease or licence under such circumstances must be made with the prior approval of the Central Government.

Under the Act, the Central Government after consultation with the State Government may undertake prospecting or mining operations in respect of

lands in which the minerals rest in Government and provided that such lands are not already leased out. Where it proposes to undertake such activity it shall do so by Gazetted notification, specifying :

(a) the boundaries of the area ;

(b) the State in which such activity will be carried out ; and

(c) the mineral or minerals concerned.

The Central Government shall pay the same rates of royalty, dead rent, surface rents, etc. as any private person.

4.8 Royalties and other levies : Holders of a mining lease in general are liable to pay royalty in respect of any mineral removed by them from any leased area at the rate for the time being specified in respect of that mineral (See Annexure 'A').

The Central Government is given power to amend the Second Schedule so as to enhance or reduce the rate at which royalty shall be payable in respect of any mineral with effect from such date as may be specified. The restrictions imposed on this power of the Central Government are :

(a) the rate of royalty fixed in respect of any mineral is not to exceed 20% of the sale price of the mineral at the pit's head ;

(b) the rate of royalty in respect of any mineral is not to be enhaced more than once during any period of four years ;

(c) certain amounts of ores and minerals are movable free of royalty for purposes other than commercial purposes (See Annexure 'C').

Royalty may be defined as share payable to a lessor in the value of mineral extracted by a lessee. After a lease has been obtained, a lessee has to pay royalty at the rate stipulated on the quantity mined. Royalty is to be deposited every six months or after expiry of a year as directed by the State Government. The rate of royalty has been fixed on a tonnage basis for all minerals mentioned in the Second Schedule of the Mines and Minerals (Regulation and Development) Act, 1957 (See Annexures 'A' and 'C').

Dead Rent may be defined as the minimum charge which a lessee has to pay to the State Government. Dead rent is payable only from the second year of the lease, if the land remains unexploited ; no dead rent is charged on the first year of the lease ; this is unlike royalty which becomes payable in the very first year if the deposit has been opened up for mining and some quantities have been produced. A lessee is required to pay either dead rent or royalty, whichever is more, and not both. (See Annexure 'B')

Surface Rent may be defined as a rent which is levied in addition to royalty or dead rent on the area used for actual mining operations out of the total land leased. The present rate of surface rent appears to be about Rs. 2.50 per hectare. The rules provide that the rate of surface rent shall not exceed the rate of land revenue per hectare.

4.9 Rule making power of Central Government. The Act provides the Central Government with the power to make rules for regulating licences and mining leases and for any purpose connected therewith. Such rules and regulations may prescribe procedure, qualifications of an applicant, the time, form and the authorities from whom such licences and leases are to be obtained. The Act casts a duty on the Central Government to take all such steps as may be necessary for conservation and development of minerals in India for that purpose and the same may be notified in the official Gazette. The Act provides the Central Government with wide powers to make rules for the following matters and all such rules are also binding upon the Government :

(a) the opening of new mines and the regulation of mining operations in any area ;

(b) the regulation of the excavation or collection of minerals from any mine ;

(c) the measures to be taken by owners of mines for the purpose of beneficiation of ores, including the provision of suitable contrivances for such purpose ;

(d) the development of mineral resources in any area ;

(e) the notification of all new borings and shaft sinkings and the preservation of bore hole records, and specimens of cores of all new bore holes ;

(f) the regulation of the arrangments for the storage of minerals and the stock thereof that may be kept by any person ;

(g) the submission of samples of minerals from any mine by the owner thereof and the manner in which and the authority to which such samples shall be submitted and the taking of samples of any minerals from any mine by the State Government or any other authority specified by it in that behalf ; and

(h) the submission by owners of mines of such special or periodical returns and reports as may be specified, and the form in which and the authority to which such returns and reports shall be submitted.

The Act expressly states that any prospecting licence or mining lease granted, renewed or acquired in contravention of the provisions of this Act or Rules or orders made thereunder shall be void abinitio and have no effect or convey any rights.

4 10 Inspection of prospecting and mining operations. For purposes of determining the actual work done under a prospecting licence or mining lease, checking any abandoned mine or for any other purpose connected with the Act, or Rules made thereunder, the Central Government may authorise any person to enter, inspect, survey, take measurements, weigh, measure any stocks of minerals, examine any document, books, registers or records of the mine and mine-holders, or order the production of any such documents. Under this power the Central Government may order the examination of any person having the control of or connected with any mine. Every person so authorised by the Central Government will be deemed to be a public servant.

4.11 Parliamentary appovals. A mandatory duty is cast upon the Government to lay before each House of Parliament for not less than 30 days all rules made and notifications issued by the Central Government under this Act, and the Parliament shall have the right to modify any such rules or notifications.

4.12 Revision The Central Government also has the power to either suo moto or upon application made within the prescribed time by an aggrieved party, revise any order made by a State Government or other Authority for exercising of the powers conferred on it by or under this Act.

5. The Mineral Concession Rules, 1960

5.1 These Rules have been framed by the Central Government under the rule making power, as provided under sections 13 and 18 of the Mines and Minerals (Development and Regulation) Act, 1957. These Rules deal comprehensively with the procedure for the grant of certificates of approval, prospecting licences, mineral concessions and mining leases in the case of lands in which the minerals vest in the Government as well as in the case of lands in which the minerals vest in a person other than the Government and also in the case of lands in which the minerals vest partly in Government and partly in private persons and deals with each set of land separately. The dispensation by which minerals vest in a person other than the Government is explained in paragraph 5.10.

5.2 Application for Certificate of Approval. Nobody can make an application for a prospecting licence unless such an application is accompanied by a certificate of approval. An application for a certificate of approval shall be made to the State Government in a prescribed form and every such application shall be accompanied by a fee of

(a) Rs. 500/- if the certificate of approval is applied for one year; or

(b) Rs. 1500/- when a certificate of aproval is applied for for three years;

(c) All applications for renewal of a certificate of approval also be made to State Government 'and every such renewal application shall be accompanied by a fee of Rs. 250/- for renewal of one year or Rs. 750/- for

renewal of three years. A certificate of approval shall be valid upto 31st December of the year in which it is granted. If it is granted in last quarter of a year, the certificate shall be valid upto 31st December of the following year.

A certificate of approval under these Rules shall only be issued to an Indian National. For the purposes of these Rules, an Indian National has the same meaning as defined under the Mines and Minerals (Development and Regulation) Act, 1957.

5.3 Applications for prospecting licences in respect of land in which the minerals vest in Government. An application for a prospecting licence or its renewal shall be made to the State Government in a prescribd form. Each application shall be accompanied by (a) a fee of Rs. 20/- for the first sq. km. or part thereof and Rs. 4/- for each addional sq. km. or part thereof; (b) an income-tax clearance certificate; (c) a certificate of approval.

An application for grant or renewal of a prospecting licence shall be disposed of within 9 months from the date of its receipt. If no such grant or renewal is made within the prescribed time, the application shall be deemed to have been refused. All licences may be renewed for one or more periods each not exceeding the period of the original licence.

The licensee shall pay such prospecting fee as may be fixed by the State Government, being not less than twenty five paise and not more than two rupees fifty paise per hectare of land covered by the licence for each year or part of a year of the period for which the licence is granted or renewed.

5.4 Conditions for grant of prospecting licences. The licensee shall not employ in connection with the prospecting operations, any person who is not an Indian National, except with the previous approval of the Central Government. A prospecting licence may also contain such other conditions as the State Government may think fit to impose, relating to the following subjects :

(i) compensation for damage to land in respect of which the licence has been granted ;

(ii) indemnity to Government against the claim of a third party for any damage, injury or disturbance caused to him by the licensee ;

(iii) restrictions regarding felling of trees on unoccupied and unreserved Government land ;

(iv) restrictions on prospecting operations in any area prohibited by any competent authority ;

(v) operations in a reserved or protected forest ;

(vi) conditions regarding entry on occupied land ;

(vii) facilities to be given by the licensee for working other minerals in the licensed area or adjacent areas.

With the previous approval of the Central Government the State Government is also authorised to impose further conditions in the licence in the interest of mineral development.

5.5 Application for grant of mining leases in respect of land in which the minerals vest in the Government. All applications for the grant of a mining lease in respect of lands in which minerals vest in the Government shall be made to the State Government in a prescribed form. Each application or renewal of a a mining lease shall be accompanied by

(a) a fee of Rs. 200/-

(b) an income-tax clearance certificate, and

(c) a certificate of approval.

Every applicant for grant of a mining lease shall, in addition deposit a sum of Rs. 500/- for meeting the preliminary expenses in connection with the grant of lease.

5.6 The grant of a mining lease in respect of land in which the minerals vest in the Government is subject to the following conditions :

(a) the lessee shall report to the State Government the discovery in the leased area of any mineral not specified in the lease, within sixty days of such discovery ;

(b) if any mineral not specified in the lease is discovered in the leased area, the lessee shall not win and dispose of such mineral unless such mineral is included in the lease or a separate lease is obtained therefor ;

(c) the lessee shall pay, for every year except the first year of the lease, such yearly dead rent within the limits specified in Schedule IV to the Rules (see Annexure 'B') as may be fixed from time to time by the State Government and if the lease permits the working of more than one mineral in the same area, the State Government may charge separate dead rent in respect of each mineral : provided that the lessee shall be liable to pay the dead rent or royalty in respect of each mineral whichever be higher in amount but not both. (See Annexure 'A').

(d) the lessee shall also pay for the surface area used by him for the purpose of mining operations, surface rent and water rate and cess at such rate, not

exceeding the land revenue, water rate and cesses assessable on the land, as may be specified by the State Government in the lease ;

(e) the lessee shall not employ, in connection with the mining operations, any person who is not an Indian National, except with the previous approval of the Central Government ;

(f) unless the State Government for sufficient cause permits otherwise, the lessee shall commence mining operations within one year from the date of execution of the lease and shall thereafter conduct such operations in a proper, skilful and workmanlike manner.

(*Explanation :* For the purpose of this clause, mining operations shall include the erection of machinery, laying of a tramway or construction of a road in connection with the working of the mine).

(g) the lessee shall at his own expense erect and at all times maintain and keep in good repair boundary marks and pillars necessary to indicate the demarcation shown in the plan annexed to the lease ;

(h) the lessee shall not carry on, or allow to be carried on, any mining operations at any point within a distance of fifty metres from any railway line except under and in accordance with the written permission of the railway administration concerned or from any reservoir, canal or other public works, or building, except under and in accordance with the previous permission of the State Government ;

(i) the lessee shall keep correct accounts showing the quantity and other particulars of all minerals obtained and despatched from the mine, the number and nationality of persons employed therein, and complete plan of the mine, and shall allow any officer authorised by the Central Government in this behalf to examine at any time any accounts, plans and records maintained by him and shall furnish the Central or the State Government with such information and returns as it or any officer authorised by it in this behalf may require ;

(j) the lessee shall keep accurate records of all trenches, pits and drillings made by him in the course of mining operations carried on by him under the lease, and shall allow any officer authorised by the Central or the State Government to inspect the same. Such records shall contain the following particulars, viz.

(a) the subsoil and terrain through which such trenches, pits or drillings pass ;

(b) any mineral encountered ;

(c) such other particulars as the Central or the State Government may from time to time require ;

(k) the lessee shall strengthen and support, to the satisfaction of the railway administration concerned or the State Government, as the case may be, any part of the mine which in its opinion requires such strengthening or support for the safety of any railway, reservoir, canal, road or any other public works or buildings ;

(l) the lessee shall allow any officer authorised by the Central or the State Government to enter upon any building, excavation or land comprised in the lease for the purpose of inspecting the same :

(m) the State Government shall at all times have the right of pre-emption of the minerals won from the land in respect of which the lease has been granted ; provided that the fair market price prevailing at the time of pre-emption shall be paid to the lessee for all such minerals.

5.7 A mining lease may contain such other conditions the State Government may deem necessary in regard to the following, viz. :

(a) the time-limit, mode and place of payment of rents and royalties ;

(b) the compensation for damage to the land covered by the lease ;

(c) the felling of trees ;

(d) the restriction of surface operations in any area prohibited by any authority ;

(e) the notice by lessee for surface occupation ;

(f) the provision of proper weighing machines ;

(g) the facilities to be given by the lessee for working other minerals in the leased area or adjacent area ;

(h) the entering and working in a reserved or protected forest ;

(i) the securing of pits and shafts ;

(j) the reporting of accidents ;

(k) the indemnity to Government against claims of third parties ;

(l) the delivery of possession of lands and mines on the surrender, expiration or determination of the lease ;

(m) the forfeiture of property left after determination of lease ;

(n) the power to take possession of plant, machinery, premises and mines in the event of war or emergency.

5.8 The State Government, if it is of the opinion that in the interest of mineral development it is necessary so to do, may, in any case. with the previous approval of the Central Government, impose such further conditions as it thinks fit. The rights of the lessee, subject to the aforesaid conditions, are as follows :

(a) to work the mines,

(b) to sink pits and shafts and construct buildings and roads,

(c) to erect plant and machinery.

(d) to quarry and obtain building and road materials and make bricks, to use water and take timber, to use land for stacking purposes, to do any other things specified in the lease.

5.9 The lessee of a mining lease, without the previous consent in writing of the State Government, cannot assign, subject, mortgage, or in any other manner transfer the mining lease, or any right, title or interest therein, or enter into or make any arrangement, contract or understanding whereby the lessee will or may be directly or indirectly financed to a substantial extent by, or under which the lessee's operations or undertakings will or may be substantially controlled by, any person or body of persons. In respect of any mineral specified in the First Schedule to the Act, the consent of the State Government is to be granted only with the previous approval of the Central Government.

Subject to this, the lessee may transfer his lease or any right, title or interest therein to a person holding a certificate of approval and an income tax clearance certificate on payment of a fee of Rs. 1000/- to the State Government.

5.10 Minerals vested in a person other than Government only prior to the present Constitution of India. These rights were granted only by some provinces when they granted Zamindaris, Inams or Jagirdaris. The purchasers of these grants purchased the land outright along with all the mineral rights, which vested in them. Such purchasers were not required to :

(a) give any portion of the land revenue recovered from their tenants on such lands to the Government ;

(b) obtain any approvals before granting a licence or lease in respect of the minerals that vested in such lands.

Under the post-Constitution Mining Legislation, these persons were converted into statutory lessees of the State and thereafter all post-Constitution mining laws became applicable to such persons.

5.11 Procedure for obtaining a prospecting licence or mining lease in respect of land in which the minerals vest in a person other than Government. The

restrictions which apply to the grant or renewal of prospecting licences and mining leases in respect of lands in which the minerals vest in a person other than the Government are in the main the restrictions applying to the same in respect of lands in which the minerals vest in the Government, viz., no prospecting licence or mining lease shall be granted to any person unless he

(a) has a certificate of approval in the prescribed form from the State Government ; and

(b) produces an income-tax clearance certificate from the income-tax officer concerned.

Furthermore, no prospecting licence or mining lease shall be granted in respect of any of the minerals specified in the First Schedule to the Mines and Minerals (Regulation and Development) Act, 1957, without the prior approval of the Central Government.

No such licence or lease shall be issued to any person who is not an Indian National.

5.12 Conditions of prospecting licence. In the case of a prospecting licence, the licensee, shall pay the grantor such prospecting fee as may be agreed upon being not less than Re. 0.25 and not more than Rs. 2.50 per hectare of the land covered by the licence for each year or a part of the year of the period for which the licence is granted or renewed and certain restrictions are also imposed by the Rules on the licensee from winning or carrying away the minerals except mica for commercial purposes. Mica may be carried away for commercial purpose on payment of royalty.

A prospecting licence may not be renewed for one or more periods exceeding the period for which the licence was originally granted. Such renewals in the case of minerals specified in the First Schedule shall only be made with the prior approval of the Central Government.

If the lessee under a mining lease makes any default in the payment of royalty or commits a breach of any of the conditions of the lease, the lessor is required to give notice to the lessee requiring him to pay the royalty or remedy the breach as the case may be within sixty days from the receipt of the notice and if the royalty is not paid or the breach is not remedied within such period, the lessor, without prejudice to any proceeding that may be taken against the lessee, can terminate the lease.

5.13 Conditions of mining lease. A mining lease can be granted by a person other than the Government only to those persons who hold a certificate of approval from the State Government and who produce an income tax clearance certificate. In respect of minerals specified in the First Schedule to the Mines and Minerals (Regulation and Development) Act, 1957, prior permission must be obtined from the Central Government.

If any mineral not specified in the lease is discovered in the leased area the lessee shall not be entitled to win or dispose of such mineral unless he obtains a separate lease for such a mineral. All other conditions attaching to the grant of mining leases as specified in paragraph (5.5) aforementioned are applicable in this connection.

However, power is reserved to the State Government to direct the parties concerned, with the approval of the Central Government, not to undertake any prospecting or mining operations in the area to which the licence or lease relates, if the State Government has reason to believe that the grant or transfer of a prospecting licence or mining lease or of any right, title or interest in such licence or lease is in contravention of the rules.

As regards prospecting licences and mining leases in respect of land in which the minerals vest partly in Government and partly in private persons, the same rules apply as in the case of grants of prospecting licences and mining leases in respect of lands in which the minerals vest in the Government.

The dead rent and royalty payable in respect of minerals which partly vest in the Government and partly in a private person is to be shared by the Government and by the private person in proportion to the shares they have in the minerals.

5.14 Revision. A person being aggrieved by any order made by the State Government or any other authority in exercise of the power conferred by these Rules may, within two months of receipt of such order, make an application for revision to the Central Government.

The application should be accompanied by treasury receipt for Rs. 100/- from any Government Treasury or branch of the State Bank of India doing treasury business.

All such applications must be accompanied by as many copies as there are parties to the dispute. Proceedings in such cases are quasi judicial. Appeals from the decisions lie to the High Court of a State.

5.15 Model forms for applications, etc. Model forms for various applications for certificate of approval, income-tax clearance, prospecting licences, mining leases and their renewals are given in Schedule I to the Mineral Concession Rules, 1960.

6. The Mineral Conservation and Development Rules, 1958

6.1 These Rules have been framed by the Central Government in exercise of powers conferred by Section 18 of the Mines and Minerals (Regulation and Development) Act, 1957. These Rules have been framed to regulate the working of mines for the conservation and systematic development of minerals. The primary responsibility for that purpose is vested in the Controller of the Indian Bureau of Mines at Nagpur.

6.2 Notices of Commencement of Prospecting and Mining Operations. The rules require every holder of a prospecting licence to give notice to the Controller of his intention to start prospecting operations at least 30 days before the commencement of such operations and an intimation of commencement within 7 days of the commencement of the prospecting operations and require certain returns to be furnished.

A similar advance notice of intention to commence mining operations is to be given by every owner, agent or manager of a mine, as well as an intimation of opening within 14 days of the opening of the mine.

Notice is also to be given to the Controller of any transfer of a prospecting licence or a mining lease and of the intention of abandonment of a mine or temporary discontinuance of work in mines as also of re-opening.

6.3 Employment of Qualified Personnel. The rules are very specific with regard to the employment of properly qualified geologists and mining engineers to carry out prospecting and mining operations in accordance with approved practices. The rules require that every holder of a prospecting licence shall employ a part time or a whole time geologist or a mining engineer ; and that a holder of a mining lease shall employ a whole time mining engineer in the case of a mine where the average employment exceeds 150 working below ground or an overall total of 400 employees in the mine. A part time engineer shall be employed in the case of a mine where the average employment exceeds 75 but does not exceed 150 in workings below ground or exceeds 150 but does not exceed an overall total of 400 in the mine.

No mining engineer shall be employed in two or more mines unless the mines are located within contiguous areas not exceeding 500 sq. kms. Neither shall a mining engineer be employed in more than three mines of the category in which the average empolyment exceeds 75 but does not exceed 150 in workings below ground or where the average employment exceeds 150 but does not exceed 400 in all in the mine.

The rules provide that if the holder of a prospecting licence or mining lease is a geologist or mining engineer, the requirment of these rules shall be deemed to have been complied with. The rules further require that a mining engineer or geologist employed by the holder of a prospecting licence or mining lease should possess the following qualifications :-

(a) Geologist — A diploma in geology from the Indian School of Mines and Applied Geology, Dhanbad or a B.Sc., (Hons.) (three years degree) in geology from any recognised University.

(b) Mining Engineer — A diploma in mining engineering from the Indian School of Mines and Applied Geology, Dhanbad or a degree in mining engineering from any recognised University.

6.4 Filing of Monthly and Annual Returns. The rules also require the filing of monthly, quarterly and annual returns by an owner, agent or managar of each mine in a prescribed form. All such reports are to be filed with the Controller. These reports must, inter-alia, contain a true and correct account with regard to the progress of the prospecting and mining operations and also a report with regard to the stocks of each mineral, the cost of transportation, royalties, dead rents, octroi and other levies paid ; the reports shall also contain the number of employees employed in the mine and the wages paid to them.

6.5 Revision. Any person being aggrieved by any order issued by the Controller under these rules may within 30 days of receipt of such an order appeal to the Central Government for revision. Upon being satisfied that there is sufficient cause for complaint the Central Government shall refer it to a Board consisting of a Chairman and not more than two officials and an equal number of persons representing the holder of the concession. The rules also require every owner, agent or manager of a mine to comply with all directions being directions for the purpose of providing for conservation and systematic development of minerals, as the Controller may, from time to time, by general or special order issue with the previous approval of the Central Government given in consultation with the State Government concerned. Such directions and orders must be notified in the official Gazette.

7. The Mines Act, 1952

7.1 This Act, as its preamble reads, is an Act to amend and consolidate the law relating to the regulation and safety of labour in mines. Its prime object is to regulate the working of the mines essentially from the point of view of labour, welfare and safety of persons working in mines.

7.2 Appointment and Powers of Chief Inspectors, Inspectors and Certifying Surgeons. The Act provides for the appointment of certain officers entrusted with the power to regulate the working in the mines subject to the control of the Central Government. The Central Government is given the power to appoint a Chief Inspector of Mines for all the territories to which this Act extends, and Inspectors of Mines subject to the control and supervision of the Chief Inspector. The Chief Inspector and Inspectors may make such examination and inquiry as they think fit in order to ascertain whether the provisions of this Act and all the regulations, rules, by-laws and any orders made thereunder are observed in the case of any mine.

The power conferred is not to be exercised in a manner which unreasonably impedes or obstructs the working of the mine. The Chief Inspector and Inspector may also examine and make an inquiry respecting the state and condition of any mine or any part thereof, the inclination of the mine, etc., and into all maters and things connected with or relating to the health, safety and welfare of the persons employed in the mine.

For the purpose of surveying, levelling or measuring any mine, the Chief Inspector or an Inspector may by a special order in writing authorise any person in the service of the Government to enter the mine and survey, level or measure the mine.

The Act also authorises the Central Government to appoint qualified medical practitioners to be Certifying Surgeons for the purpose of this Act. No person shall be appointed as a Certifying Surgeon who is or becomes an owner, agent, manager of a mine or who has become directly or indirecly interested in a mine or any business connected with a mine.

The Certifying Surgeon shall carry out any duties which may be prescribed in connection with the examination and certification of illnesses, adolescents and persons engaged in a mine in dangerous occupations or work which may cause injury.

7.3 Mining Boards and Committees. Apart from these authorities, the Central Government is given the power under the Act to constitute a Mining Board, for any part of the territories to which the Act extends, or for any group or class of mines.

The Act empowers the Central Government to form Mining Boards with a representation of two persons nominated by the owners of mines or their representatives and two persons to represent the interests of persons employed in mines. The Government has the right to appoint 3 persons as its representatives on the Board. One of the Government's representatives, not being the Chief Inspector or Inspector, but being a Government Servant, shall act as Chairman of the Board. Out of the Government's other two representatives on the Board, one of them may be the Chief Inspector or an Inspector. The act also makes provision for two persons nominated by the registered trade unions to represent the interest of miners (miner means a person employed, otherwise than in a position of supervision or management in any of the mines) if there are one or more registered unions having in aggregate as members not less than one quarter of the miners. If this clause is not applicable and there are one or more registered trade unions having in the aggregate as members not less than one thousand miners, one of the persons is nominated by the trade unions and the other by the Central Government. The purpose of constituting such a board is to ensure that labour welfare and safety are promoted, by review from time to time of any Government regulations issued in connection therewith. If a Board is in existence the Government is bound to consult it although its concurrence in Government decision is not necessary.

The Act further provides for the constitution of a Committee to which any question relating to the mine may be referred under the Act. The Committee is to hear and record such information as the Chief Inspector or the Inspector, or the owner, agent or manager of the mine concerned, may place before it, and it intimates its decision to the Chief Inspector or the Inspector and to the

owner, agent or manager of the mine and reports its decision to the Central Government. On receiving such report, the Central Government is empowered to pass orders in conformity therewith unless the Chief Inspector or the owner, agent or manager of the mine has lodged an objection to the decision of the Committee, in which case the Central Government may proceed to review such decision and to pass such orders in the matter as it may think fit ; but in the case of an objection lodged by the Chief Inspector, notice of the same is to be given to the owner, agent or manager of the mine before any orders are passed thereon by the Central Government.

Any Mining Board and any Committee constituted as aforesaid may exercise such of the powers of an Inspector under the Act as they think necessary or expedient to exercise for the purpose of deciding or reporting upon any matter referred to it, and they also have the powers of a Civil Court under the Code of Civil Procedure 1908 (Act V of 1908) for the purpose of enforcing the attendance of witnesses and compelling the production of documents and material objects.

The Central Government is empowered to direct an owner or agent of the mine concerned to bear the whole or any part expenses of any inquiry conducted by the Mining Board or Committee appointed or constituted under the Act.

7.4 Notice to be given of Commencement of Mining Operations. This Act also requires the owner, agent or manager of a mine to give to the Chief Inspector of Mines, the Controller of Indian Bureau of Mines and the District Magistrate of the district in which the mine is situated a notice in writing in the prescribed form before the commencement of any mining operation so as to reach the concerned officers at least one month before the commencement of any mining operation.

The Act requires that every mine, except in prescribed cases, shall be under one manager who shall have the prescribed qualifications and shall be responsible for the control, management, supervision and production of the mine and the owner or agent of every mine shall appoint himself or some other person having such qualifications to be such manager.

It is the responsibility of the owner, agent and manager, of every mine, that the operations carried on in connection therewith are conducted in accordance with the provisions of the Act and of the regulations, rules and by-laws and of any orders made under it.

7.5 The Act also prescribes the various amenities such as cool, wholesome drinking water, canteens, etc., and medical appliances, first aid equipment, arrangement for conveyance to a hospital or dispensary to be provided in every mine. Powers are also given to the Chief Inspector and other Inspectors to take steps to ensure in an effective manner the safety of any person in a mine and require

the owner, agent or manager of a mine to remedy or avoid any thing dangerous or defective.

The Act requires that notice should be given of all accidents occuring in a mine and power is given to the Central Government to appoint a Court of Inquiry in cases of certain accidents if it is of the opinion that a formal inquiry into the circumstances causing the accident ought to be held. Notice is also required to be given where any person employed in a mine contracts any disease notified by the Central Government as a disease connected with mining operations and the Central Government is given the power, if it considers it expedient to do so, to cause investigation into such cases also. Medical certificates of fitness shall be in a prescribed form and valid for 12 months from the date of issue.

7.6 Hours and Limitation of Employment. The Act also prescribes various conditions of work. Differentiation is made between work on the surface and work in the mine and special protection is given to women and adolescents. Adolescents are not permitted to be employed to work in any part of a mine which is below ground unless their sixteenth year is completed and they are certified to be fit to work by the Certifying Surgeon. Women are not allowed to work in any part of a mine which is below ground and in any mine above ground except between the hours of 6 a. m. and 7 p. m.

7.7 Hours of Work above ground. No adult employed above the ground in a mine shall be required or allowed to work for more than :—

(a) 48 hours in any week or more than 9 hours a day.

(b) 5 hours continuously without a half hour break.

All work periods of an adult shall be so arranged that along with his interval of rest, they shall not spread over more than 12 hours in any day. This period may be extended to 14 hours provided the Chief Inspector records his reasons in writing.

7.8 Hours of work below ground. No adult employed below ground in a mine shall be allowed to work for more than 48 hours in any week or more than 8 hours in any day and by a system of shifts which shall not exceed the limit of 8 hours a day. No person employed in a mine shall be allowed to be present in any part of a mine below ground except during the periods of work shown against his name in the job register.

7.9 Rest. No person shall work for more than six days in a week. In case a person is deprived of any weekly day of rest, he shall within the month or within two months immediately, be entitled to compensatory days of rest equal in number to the days of rest of which he has been deprived.

Where a person employed in a mine works on shift which extends beyond mid-night, he shall be entitled to a rest period of 24 hours, commencing from the time his shift ends.

7.10. All persons working in a mine above or below ground shall be entitled to extra wages for overtime at a rate twice his ordinary rate of wages calculated on a daily or weekly basis whichever is more favourable to him.

For leave allowed, a person employed in a mine shall be paid at a rate equal to the daily average of his full time earnings for the days on which he was employed immediately preceding his leave, excluding overtime wages but including dearness allowance.

7.11 Rules and Regulations Making Power of Central Government. The Central Government is given the power to make rules and regulations with regard to a number of matters such as qualification of Inspectors, medical examination of employees, sanitary conditions, appointment of Courts of Inquiry, hours of work, preventions of accidents, safety, convenience and discipline of the persons employed in the mines.

7.12 The act also empowers the Central Government by notification to exempt, either absolutely or subject to any specified conditions, any local area or any mine or group or class of mines or any part of any mine or group of class of mines or any class of persons, from the operation of all or any of the provisions in the Act. The Act is also made applicable to mines belonging to Government. The Act also empowers the Central Government to apply, subject to modifications that may be made, the provisions of Chapters 3 and 4 of the Factories Act, 1948 (which deal with health and safety) to all mines and precincts thereof.

8. The Mines Rules, 1955

8.1 These Rules are framed by the Central Government in exercise of powers conferred by Section 58 of the Mines Act, 1952. These Rules provide the constitution and the procedure for the working of Mining Boards, Courts of Inquiry, wages, working conditions of the employees, Certifying Surgeons and matters relating to safety and health of the workers in mines. Under the Rules, Welfare Officers shall be appointed in any mine wherein 500 or more persons are employed. An additional Welfare Officer shall be appointed in a mine where the employees exceed 2500, for every additional 2000 employees. The duties of these officers are primarily to establish and ensure industrial peace and harmonious relations between the management and labour.

8.2 Under the Rules, the First Aid Room shall be in charge of a qualified medical practitioner ; where the number of persons ordinarily employed in a mine is more than 1000, such a medical practioner shall be a whole time employee at the mine. The medical practioner shall be assisted by

a nurse or a dresser or a compounder who is qualified in the Allopathic system of medicine. The nurse, compounder or dresser shall be a whole time employee of the mine. Furthermore, every mine wherein more than 250 persons are ordinarily employed, a canteen shall be provided for the use of such persons. A supply of hygienic and cool drinking water shall also be maintained at all times at a mine.

9. The Metalliferous Mines Regulations, 1961

9.1 These rules are framed by the Central Government in excercise of the powers conferred under Section 57 of the Mines Act, 1952. They provide in detail for the various precautions to be taken and the various specifications to be followed in working mines and also require various officers to be appointed by the management and prescribe the qualifications required for such officers.

9.2 They also provide for the constitution of a Board of Mining Examinations and prescribe the various certificates of competency and fitness to be given by the Board of Mining Examinations and the examinations to be conducted for that purpose.

9.3 The Regulations provide that no mine shall be opened, worked or re-opened unless there is a manager of the mine; such manager must be a person duly appointed and having such qualifications as prescribed by these Regulations. A manager can be appointed for more than one mine only with the previous permission in writing of the Chief Inspector and subject to the conditions that the Chief Inspector may specify. Assistant managers or underground managers shall be appointed in every mine, the average employment of which exceeds 450 in workings below ground or 1,200 in all in the mine.

9.4 There are regulations also dealing with the appointment, qualifications, duties and responsibilities of engineers, surveyors, foremen, etc., and other specialist workers in the mines, such as mining mates, blasters, timber men, etc. The owners ofmines are required to keep plans and sections in the manner provided in the Regulations.

9.5 There are provisions also dealing with the means of access and exit, ladders and ladderways, transportation of men and materials, winding in shafts, haulage and other details regarding the workings of a mine and precautions to be taken against dangers from fire, dust, gas and water, requirements of ventilation, lighting and safety lamps, the use of explosives and shot fire, the use of internal combustion engine or steam boiler below ground and the construction and maintenance of machinery.

10. The Iron Ore Mines Labour Welfare Cess Act, 1961

10.1 This Act is an act of Parliament and it provides for the levy and collection of a cess on iron ore for the financing of activities to promote the welfare of labourers employed in the iron ore mining industry. It extends to the whole of India.

10.2 The said Act provides for the levy and collection as a cess on all iron ore produced in any mine, a duty of excise at a rate not to exceed 50 paise per tonne of iron ore. All such levies shall not be made or collected unless notified in the official Gazette by the Central Government.

10.3 The Act provides that after due appropriation made by Parliament, the Central Government shall deduct the costs of collection of the cess from the whole amount collected on account of such cess. The balance of the cess together with any income from the investment of the said amount and any other monies received by the Central Government for the purposes of this Act shall be used to defray the cost of measures for benefit of labourers employed in the iron ore mining industry and in particular :--

(a) to provide and improve measures for public health, sanitation, prevention of diseases, medical facilities, water supply facilities for drinking and washing, educational facilities, standards of living, housing, nutrition, and recreation facilities, provision of transport to and from work ;

(b) to make grants-in-aid to State Governments or Local Authority, or owners of iron ore mines, or any other person of money in aid of any scheme approved by the Central Government for any of the purposes of the Act ;

(c) to pay annual grants-in-aid to such of the owners of iron ore mines to provide to the satisfaction of the Central Government welfare facilities of a prescribed standard for the benefit of the labourers employed in their mines. However, the amount so payable shall not exceed the amount spent by the owner himself in the provision of welfare facilities as determined by the Central Government or such amount as may be prescribed by the rules made under this Act, whichever is less ;

(d) to meet the allowances of any of the members of an Advisory Committee constituted under Act and also to meet the salary and allowances of any person or persons appointed as Inspectors, Welfare Administrators and such other officers and staff to advise the Central Government on such matters arising out of the administration of this Act.

11. The Mica Mines Labour Welfare Fund Act, 1946

11.1 This is a Central Act. The main purpose of the Act is to provide a fund for the financing of activities to promote the welfare of labour employed in the mica mining industry.

11.2 The Act provides for the levy and collection of a cess on all mica in whatever state exported from the territories to which this Act extends, and such a cess shall not exceed 6¼%ad valorem. Such a cess shall not be collected unless notified by the Central Government in the official Gazette. All the proceeds collected from the levy of this cess shall on the last day of each month or as soon thereafter as may be convenient, be credited to a fund to be called "Mica Mines Labour Welfare Fund", after deduction of all expenses, if any, for collection and recovery of the cess.

11.3 The fund shall be applied by the Central Government to meet the cost of measures for the benefit of labour employed in the mica mining industry and in particular :—

(a) to the improvement of public health, sanitation, prevention of diseases, provision and improvement of medical facilities, water supplies, educational facilities, standards of living, housing, recreational facilities and transport, etc.,

(b) to grant to the State Government or local authority or the owner, agent or manager of mica mines, of money in aid of any scheme approved by the Central Government for any purpose for which the funds may be utilized.

(c) The cost of administering the fund including the allowances, if any, of members of the Advisory Committees appointed under the Act and the salaries and allowances of officers appointed under the Act and any other expenditure incurred by the Central Government for the purpose of this Act. The decision of the Central Government as to whether any particular expense is debitable or not to the fund shall be final.

(d) The Central Government shall publish annually a report of the activities financed from the fund together with all receipts and expenditure of funds and a statement of account.

12. Mica Mines Labour Welfare Fund Establishment Contributory Provident Fund Rules, 1950

12.1 These rules have been framed by the Central Government under the rule making power provided under Section 6 of the Mica Mines Labour Welfare Act, 1941. These rules provide for the setting up of a Contributory Provident Fund which shall be administered by the Controlling Officer of the mine.

12.2 The rules shall apply to every employee holding a permanent and non-pensionable post in a substantive capacity. The amount of subscription shall be fixed by the subscriber himself subject to the following conditions :—

(a) If the emolument of the subscriber exceeds Rs. 50/- a month, the amount may be in multiples of half a rupee.

(b) It may be in a sum so expressed at a rate not exceeding 12% i. e. 12 paise in the rupee and not less than 6¼% i. e. 6 paise in the rupee from his monthly emoluments.

(c) In the case of an employee who under the rules is allowed to join the Provident Fund with retrospective effect such monthly subscription shall not be less than 10% of his pay until all arrears of such subscriptions are paid in full.

ANNEXURE 'A'

RATES OF ROYALTY ON MINERALS

(As per Section 9 of Second Schedule of the Mines and Minerals (Regulation and Development) Act, 1957, with amendments incorporating the latest rates of royalty, Gazetted on 1.7.1968)

Minerals	Rates of Royalty
Mica	
(a) Crude mica	Rs. 6.00 per 100 kg.
(b) Trimmed mica of heavy-stained, dense-stained, or spotted second quality	Rs. 5.00 per 100 kg.
(c) Trimmed mica of qualities other than (b)	Rs. 10.00 per 100 kg.
(d) Waste & scrap mica	Rs. 2.00 per 100 kg.
(e) Waste rounds	Rs. 2.50 per 100 kg.
Iron	
(i) Ore	
(a) containing more than 62% Fe	Rs. 1.50 per tonne
(b) containing upto 62% Fe	Re. 1.00 per tonne
(ii) ore finer in size less than 1.25 centimetres, produced incidental to mining and sizing of ore	Re. 0.25 per tonne
(iii) Red Oxide	Rs. 2.00 per tonne
Manganese	
(a) Manganese dioxide (containing 78% or more MnO_2 and 4% or below Fe)	Rs. 15.00 per tonne
(b) Manganese Ore	
(i) 46% Mn and over	Rs. 6.00 per tonne
(ii) 35% Mn and above but below 46% Mn	Rs. 3.00 per tonne
(iii) Below 35% Mn but above 25% Mn	Rs. 2.00 per tonne
(iv) 25% Mn and below	Re. 1.00 per tonne

Chromite	
(a) Containing 45% Cr_2O_3 and above	Rs. 10.00 per tonne
(b) Containing less than 45% Cr_2O_3	Rs. 6.00 per tonne
(c) Chromite concentrates in fines prepared through crushing and panning (irrespective of percentage content of Cr_2O_3)	Rs. 3.00 per tonne
Kyanite	
(a) 60% Al_2O_3 and above	Rs. 25.00 per tonne
(b) below 60% and above 40% Al_2O_3	Rs. 8.00 per tonne
(c) 50% Al_2O_3 and below	Rs. 4.00 per tonne
Copper Ore	Rs. 3.25 per unit per cent of copper metal per tonne of ore and on prorata basis.
Lead Ore	Re. 0.75 per unit per cent of metal per tonne of ore and on prorata basis.
Zinc concentrates	Re. 1.00 per unit per cent of zinc metal contained per tonne of ore and on prorata basis.
Bauxite all grades	Rs. 2.50 per tonne.

ANNEXURE 'B'

(SCHEDULE IV MINERAL CONCESSION RULES, 1960)

See Rule 27 (i) (c)

Dead Rents as applicable from 1.4.1968

Period of the Mining Lease	Rate of Dead Rent per Hectare
1st Year	Nil
2nd Year to 5th Year	Rs. 12.50
6th Year to 10 Year	Rs. 25.00
11th Year onwards	Rs. 37.50

ANNEXURE 'C'

MAXIMUM QUANTITIES OF ORES AND MINERALS MOVABLE FREE OF ROYALTY

(Schedule III, Mineral Concession Rules, 1960)

(See Rule 14 (i) (ii) (a))

Class	Mineral	Quantity.
1	Metalliferous ores meant for extracting aluminium, iron and manganese.	10 tonnes.
2	Metalliferous ores meant for extracting chromium, copper, lead and zinc.	5 tonnes.
3	Concentrates of the ores enumerated in class 2.	100 kgs.
4	Iron pyrites and bauxite used for other than aluminium making.	5 tonnes.
5	Mica and native sulphur.	50 kgs.
6	Kyanite.	50 tonnes.

During the tenure of a prospecting licence, a provision has been made for the licensee to take out stipulated quantities of minerals free of royalty for purposes other than commercial purposes. The intention of such stipulation is that the quantity ordinarily required for preliminary tests, beneficiation or research may only be moved free of royalty. A licensee can also remove minerals in excess of the limits, on payment of royalty, but not exceeding twice such limits except in the case of mica and kyanite. For mica a limit of 10 tonnes is prescribed for the quantity that can be carried away on payment of royalty, and for kyanite no limit is prescribed.

CHAPTER II—ADMINISTRATIVE AGENCIES

1. The Department of Mines

1.1 The MMRD Act of 1957 seeks to regulate the exploitation principally of major minerals ; exploitation of minor minerals is subject to the provisions relating to submission of operating returns and certain other minor provisions. As defined in the Act, minor minerals are only of local and small interest ; minerals which are of importance to the national economy, especially export economy, are all included in the class of major minerals. The MMRD Act thus vests the Central Government with almost all--pervasive authority in the exploitation of the country's mineral resources. A certain measure of decentralisation is provided by requiring that matters relating to the grant of mineral concessions in respect of only those minerals included in the First Schedule to the Act be referred to the Centre for prior approval. However, a party aggrieved by any decision of a State with respect to his rights for exploitation of a major mineral has recourse to the Centre by filing a revision petition.

1.2 The Central Government seeks to discharge its responsibility and excercise its authority in respect of development of the mineral resources through the Ministry of Steel and Mines, under a Cabinet Minister. The Cabinet Minister is assisted by a Minister of State having Mines as his sole portfolio.

1.3 The Department of Mines at the Centre provides the administrative machinery through which the authority and responsibility of the political executive are exercised. The Department has at its head a Secretary. Action in respect of different executive problems of different sectors of the mineral economy is delegated to three Joint Secretaries and through them to the officers of lower rank. The Department also performs staff functions of advising the political executive on policies. Technical expertise in mining is provided to the Department by three advisers, one Chief Technical Adviser and two Senior Mining Advisers.

1.4 The important functions discharged by the Department of Mines in respect of granting of mineral concessions are :

(i) passing on any award (or renewal) by a State of a mineral concession in one of the minerals in the First Schedule to MMRD Act ;

(ii) passing on the granting of a Certificate ot Approval or the award (or renewal) of a mineral concession to one not an Indian national ;

(iii) entertaining revision petition by any party aggrieved by the ruling of a State Government with respect to the award, renewal or cancellation of a mineral concession or any other ruling it is competent to make under the MMRD Act.

While the first and third of the functions above usually are discharged entirely by the administrative machinery, decisions on the second function invariably are taken by the political executive. Ventures with foreign collaboration would normally be brought to the notice of the Central Government or attract its attention even where they statutorily not required to be so treated.

Administrative officials queried on the policy on the award of concessions in minerals in the First Schedule said that the rationale for the classification of the minerals in the First Schedule was the Industrial Policy Resolution of 1956, which states that development of these minerals would primarily be by the public sector. The position generally taken is that if the Central Government, Government of the State concerned or any public sector organisation eligible to exploit the mineral in the area concerned evinces an interest in the concession, the concession will be granted in the first instance. However, the Central Government frowns on the pre-emption by the public sector of resources it is not in a position to exploit within reasonable time and on an appropriate scale. In many such instances the Centre has strived to obtain a release from the State or public sector body concerned so that the concession can be thrown open to private exploitation.

The Department receives a large number of revision petitions from parties aggrieved by rulings of State Governments ; the rulings often contested are those relating to the award, renewal or termination of a mineral concession. The powers granted to the Centre under the relevant provision in the MMRD Act, and detailed in the Mineral Concession Rules (1960) are wide. They include the condoning of delays by the petitioners and also envisage the Centre's intervention on its own initiative. The rulings of the Centre made under these proivions are mandatory i.e. the State Governments are obliged to execute the orders passed. During 1970 the Department received 630 petitions, as against 500 in 1969. In 1970 rulings were made on 468 petitions.

Administration officials cite the revision powers of the Centre as an effective instrument to alleviate difficulties reported by mine owners and financing bodies as standing in the way of financing mining operations. These are treated in detail while analysing credit facilities in a later Part.

1.5 Article 18 of the MMRD Act declares it to be "the duty of the Central Government to take all such steps as may be necessary for the conservation and development of minerals in India" and empowers the Central Government to "make such rules as it thinks fit". The Article goes on to specify the many matters which such rules may cover.

Under the powers granted by the Article, the Mineral Conservation and Development Rules (1958) were formulated. The MCDR nominates the Controller of the Indian Bureau of Mines (IBM) as the principal agent for overseeing the mining operations in the country from the point of view of conserving the

mineral resources of the country and development of these resources in the optimal manner. The organisation and the activites of the IBM are described under a separate head later in this Chapter. The Central Government possesses the power of revision of any ruling by the Controller of the IBM, on a petition by the aggrieved party.

While the IBM may be said to have been vested with the day to day responsibilities in conservation and development, long range planning for the optimum utilisation of the mineral resources may be said to be directly the responsibility of the Department. For such long range planning, an assessment of the country's resources is indispensable. The Geological Survey of India (GSI), a technical body under the administrative control of the Department of Mines, has been given the responsibility for mapping the geological features of the country and developing information leading to scientific assessment of the mineral resources. The organisation and activites of the GSI are described under a separate head later in this Chapter.

It cannot be said that competent long range planning has been accomplished in any of the minerals, perhaps because sufficient information has not yet been developed. Even where adequate information on the country's resources is available, making forecasts of the demand for these minerals in the country and the world in the future, of the prices that are likely to rule and of the costs of extraction and marketing of the minerals poses a formidable problem. Short range planning for the purpose of the formulation of the Five Year Plans is made by "Sub-groups" nominated for this purpose, containing representatives from the Department of Mines, the Planning Commission and other concerned Government and private bodies. Domestic demand, possible export earnings and import substitution are important considerations in the preparation of short range plans.

1.6 An important function of the Department is the identification and study of difficulties encountered by the mining industry and the formulation of measures for their amelioration. One of the instruments forged for the performance of this function is a forum, the Mineral Advisory Board, on which are represented Central and State Governments, concerned Government agencies, the industry and research insitutions performing investigations of interest to the mineral industry. The Board meets once every year. An agenda for the annual Board meeting is compiled by the Department, containing the problems cited by the various parties, often accompanied by suggestions for their solution. The latter take the form of amendments to the legislation, rules and regulations, changes in administrative policy and practice or changes to fiscal measures affecting the economy of the industry. The Department appends to each contribution to the agenda an analysis of the problem and the suggested solution. The agenda thus compiled is taken up for consideration at the following annual meeting of the MAB.

Many problems raised at the annual MAB meeting are referred for deeper study or action recommendation to the Board's Standing Committee, a compact group with Government and industry representation. Often special "working groups" or committees are formed for the purpose of studying larger problems. In recent years, working groups have been formed for studying the problems of the manganese industry and the mica industry. Committees have been assigned to work on the simplification of the rules and regulations on mining, and to evolve an appropriate operational definition of the term "workmanlike manner", as the Mineral Concession Rules require that the holder of a mining lease conduct his operations in a "proper, skillful and workman-like manner", under penalty of termination of the lease for violation of this requirement.

Over the years, several amendments to mining legislation proposed and discussed at the MAB meetings, have received general acceptance. They are being codified, and are likely to be enacted at an appropriate time.

1.7 In the interest of faster development of domestic production of important minerals and metals, and in tune with the recommendation contained in the Industrial Policy Resolution of 1956, the Central Government has set up a number of public sector undertakings to exploit the resources in various minerals. These undertakings are under the administrative control of the Department of Mines.

The National Mineral Development Corporation (NMDC) has been given a major role in the exploitation of the iron ore reserves of the country. The important deposits it is developing are at Kiriburu, Bailadila, Donimalai and Kudremukh. The Kiriburu mines, which have been producing and exporting at an average rate of 1.6 million tonnes (MT) of ore per year since 1964, are being expanded to a capacity of 4.5 MT per year and all the ore will be supplied to to the Bokaro steel plant under construction. One deposit at Bailadila (No. 14) has been developed to a capacity of 4 MT per year. Another deposit (No. 5) is being developed to achieve a capacity of 4 MT per year by 1974. Bailadila ore is earmarked for export. The large deposits in Donimalai in Mysore are being developed to achieve a capacity of 1.75 MT of lump ore and 0.5 MT of blue dust. A very interesting and important project, at Kudremukh, is being undertaken with financial and technical participation by U. S. and Japanese firms ; it will exploit the magnetite deposits and export the ore in the form of sinter feed and/or pellets and/or slurry.

The NMDC has also been given the responsibility for mining diamond, other precious stones and some of the rock phosphate deposits.

The Hindustan Zinc Ltd. (HZL) has prime responsibility for developing and exploiting the zinc-lead reserves in the country. At its complex in Rajasthan it mines ore, produces zinc and produces lead concentrates for conversion to lead at Tundoo in Bihar. Among the projects on hand are expansion

at its Rajasthan operation and establishment of a zinc smelter at Vishakhapatnam, to use imported concentrate as feed. It is also working on the development of important deposits at Debari in Rajasthan, and Sargipalli in Orissa.

The Hindustan Copper Ltd. (HCL) has prime responsibility for exploiting the copper reserves. Its principal operation is at Khetri, where it is developing mines to produce approximately 10,000 tonnes of ore a day, which will be processed in a concentrator and a smelter to yield 31,000 tonnes of copper per year. The project is expected to achieve full capacity in 1977. Another important project is at Rakha in Bihar, where foreign technical assistance is being sought to develop mines to a capacity of 20,000 tonnes of ore per day, with matching concentrator and smelter capacities. Work on developing smaller deposits at Agnigundala in Andhra Pradesh is under way.

The Pyrites, Phosphates and Chemicals Ltd. (PPCL) has concentrated on development of pyrite mines at Amjhore in Bihar. The mine is presently producing about 230 tonnes per day, and is being expanded. Detailed exploration and beneficiation studies are under way at Saladipura in Rajasthan, another large deposit of pyrites.

Manganese Ore (India) Ltd. (MOIL) is a joint venture in which the Central Government and the States of Maharashtra and Madhya Pradesh among them hold 51 per cent of the share capital and 49 per cent is held by a private company. The company operates a number of mines in Balaghat district of Madhya Pradesh and Bhandara and Nagpur districts of Maharashtra. In 1969-70, the company produced 226,000 tonnes, and the target for 1970-71 was 285,000 tonnes.

2. The Directorate General of Mines Safety

2.1 Introduction

2.1.1 Administration of the Mines Act (1952) and the rules made thereunder is the responsibility of the Ministry of Labour, Employment and Rehabilitation. The Directorate General of Mines Safety (DGMS) is the organisation to which this responsibility has been delegated. The first concrete proposals for the inspection and regulation of mining operations in India came in 1890 from the then Secretary of State, Lord Cross. In 1902, the Government of India created a "Bureau of Mines Inspection" with a nucleus of officers drawn from the Geological Survey of India. In 1904, the Bureau was renamed as "The Mines Department" and its headquarters was shifted from Calcutta to Dhanbad. From January 1960, the name was changed to "Office of the Chief Inspector of Mines". Since 1st May 1967, the organisation has been called "Directorate General of Mines Safety". Consequently, the designation of the Chief Inspector of Mines has been changed to the Director-General of Mines Safety. Corresponding changes also took place in the designations of other officers.

2.2 Organisational Set-up

2.2.1 The head of the organisation is the Director-General of Mines Safety. There is one Deputy-Director General to assist the Director-General in his work. The set up can be classified on the basis of Head Office and Field Organisations.

At the Head Office there are two Directors one each for 'Safety Standards' and 'Mines Development'. A Senior Law Officer and another Law Officer are posted to look into the legal aspects of the Directorate. There are seven Joint Directors as heads of different departments of examinations, mines safety equipments, vocational training, etc.

For convenience in administration, the country has been divided into five zones viz. Eastern Zone, South Eastern Zone, South Zone, Central Zone and Northern Zone with headquarters at Sitarampur, Ranchi, Oorgaum, Nagpur and Dhanbad respectively. A Director of Mines Safety is in over all charge of of the zone. There are 15 Inspection Regions grouped together under these 5 zones. The area in Western India comprising the States from Jammu and Kashmir in the North to Gujarat in the South, has so far, not been raised to the status of a zone. This area constitutes a region, the 16th Inspection Region, with headquarters at Ajmer (Appendix I). Each Inspection Region is under the charge of a Joint Director of Mines Safety. Each zone has been provided with Deputy Directors specialised in different mining problems, e. g. electrical, mechanical industrial hygiene, vocational training, etc.

According to norms, a Director of a Zone has to spend minimum of 100 days, a Joint Director 140 days and a Deputy Director 180 days in the field per year. The officers of the organisation visit a mine when permission for new-workings is sought. Periodic visits by the officers are organised according to set priorities. They may also make surprise checks to observe the working of mines.

Serious or fatal accidents and other urgencies call for immediate attention from the regional authority. According to the seriousness of the situation or importance, successive higher authorities have to go to the site. For example, during rock-bursts, inundation or fires, the Deputy Director usually prepares the first report and submits it to the Joint Director. If the magnitude of the problem demands it, the Joint Director will request the Zonal Director to make a visit. In other cases, he looks into the matter himself and submits report to the Zonal Director.

2.3 Functions

2.3.1 The DGMS is charged with the following statutory work:

(a) Enforcement of the Mines Act and the Rules, Regulations, bye-laws, etc., made thereunder;

(b) Enforcement of Maternity Benefit Act, 1961, and of the rules framed thereunder and of the Mines Creche Rules, 1966 in mines other than coal mines;

(c) Investigation into mine accidents and into cases of explosions, inundations, fires in mines; and prescribing suitable remedial measures to prevent recurrence of similar happenings;

(d) Inspections of mines (and the mechanical and electrical installations thereof) with a view to ensuring safety of persons and preventing dangerous occurrences in mines;

(e) Specifying conditions for working mines beneath rivers, built-up areas, roads, etc. and for reduction/extraction of pillars/blocks;

(f) Investigation into complaints regarding breaches in statutory provisions.

The DGMS has also been assigned certain responsibilities under the Coal Mines (Conservation and Safety) Act, 1952, regarding conservation of coal and safety of coal mines. Besides, under the Land Acquisition (Mines) Act, they derive powder to impose restrictions on mining adjacent to or beneath railway lines.

2.3.2 The DGMS also administers the Coal Mines Rescue Rules which provide for the establishment and maintenance of rescue stations in all coal-fields.

The two Boards of mining examinations, constituted under the Mines Act, conduct various examinations for the grant of competency certificates to work in statutory posts in both coal and metalliferous mines.

The DGMS collects mineral and labour statistics from mines and publishes a monthly coal bulletin, a quarterly bulletin for metalliferrous mines in India, and annual Indian Coal Statistics, and Statistics of Mines in India (both coal and non-coal).

2.3.3 The DGMS also advises mine managements, workers' organisations, Government and local bodies on mining matters, whenever required.

2.4 Implementation of Regulations

2.4.1 In the course of the survey, mine owners were asked for their opinions on the effect of the Mines Act and the rules made under it, and their implementation by the DGMS. Generally, it was conceded that legislation on the subject of labour in mines, and safety, was needed. It was held that the present legislation was too specific and impracticable in some respects. Labourers do not use many of the amenities required to be provided. The Creche Rules and maternity benefits required to be provided prove expensive. Mines owners said that either the regulations should be made less severe, or the DGMS should

provide for relaxation in their application, laying down standard procedures for it and not leaving it too dependent on the discretion of the Inspectors.

2.4.2 At the DGMS, it was stated that it was well aware of the problems of mine owners. and had modified its policies and procedures from time to time in order better to serve the industry.

During their visits, Inspectors observe the habits of mine workers and note the extent to which they make use of the amenities provided. They also study the lay-out and operation of the mine, with a view to judging the applicability of various safety provisions required by the regulations. On the basis of the report made by the Inspector, and of his recommendation, the DGMS decides on the granting or refusal of exemptions. In 1970, the DGMS had granted exemptions to 298 mines, mining other than coal, constituting about ten per cent of the mines in the country.

Recently, an improvement had been made in the period of validity of these exemptions. Formerly the exemption was valid only for twelve months. If the Inspector could not visit the mine within this period, and the mine did not provide the exempted amenities by the end of this period, the latter would be technically in violation of the regulations. Now, the exemption is valid until the subsequent visit of the Inspector.

2.4.3 With regard to safety, the DGMS has collected good statistical data on injuries. The data shows that about fifty per cent of the injuries could have been avoided if the prescribed safety equipment had been used. Therefore the DGMS must exercise care in granting exemptions in this respect. The DGMS conducts by itself, or sponsors, research in better and/or cheaper designs of protective gear. A committee formed for the purpose of investigating foot-wear has recommended six types of foot-wear to suit different working conditions in mines.

As the time of giving vocational training to mine workers, which the DGMS is required to do, instruction is given also on safe working habits. The DGMS thinks that there is need for mine owners taking greater initiative in sustaining the practice of safe working habits by the workers.

3. State Level Administration

3.1 In the major minerals, the State Government has the following authority :

1. Granting and renewal of Certificates of Approval. In the case of a person not an Indian National, prior approval of the Central Government is required.

2. Granting and renewal of mineral connessions. In the case of a concession in any of the minerals in the First schedule to the MMRD Act or to one

not an Indian National, prior approval of the Central Government is required.

3. Collection of prospecting fee, dead rent, surface rent, water charges and royalty, as appropriate.

4. Supervision of the operations of a concessionaire.

5. Levying of penalty for non-compliance by concessionaire with conditions attached to the concession, including termination of the concession under specified conditions.

All rulings made by a State Government in respect of grant, renewal or termination of a concession or the levying of a penalty can be contested by the aggrieved party in a revision petition to the Central Government.

The State Government, of course, is interested in the development of the mineral resources of the State, and takes measures for this purpose. These include geological investigations by the State, financing facilities, establishment of public sector bodies for mineral exploitations, publicity, etc.

3.2 In fourteen States out of the nineteen in the Union, mineral development is administrated by a Department which also has the responsibility for industrial development in the State. There is a separate Department for mining in Assam, Bihar and Orissa. A Natural Resources Department supervises mineral development in Madhya Pradesh. In Meghalaya mineral development is under the Chief Secretary. In Goa, a Union Territory, the Industries and Labour Department is the administrative agency concerned.

The Department of Mining and Geology, in those States in which there is a separate Department, or the Directorate of Mining and Geology in the other States, is the agency responsible for generating more information on the State's mineral resources and exercise of the State's authority and responsibility in respect of mining activities, subject to supervision by administrative superiors, where present, and the political executive. For convenience, the term DMG is used for the agency.

3.3 On geological investigations, the DMG co-operates with the Geological Survey of India in division of unmapped area for investigation. Where preliminary mapping has been done, the DMG takes up for detailed investigation areas of promise. The DMG also undertakes publication, in the form of periodicals or special booklets, of information on the mineral resources of the State.

3.4 The Mineral Concession Rules (1960) have laid down the principles on which mineral concessions should be given. The Rules require that the State maintain

certain documents with respect to the grant of mineral concessions and specify certain conditions which should be attached to the grant of the mineral concessions. The MCR also specifies pro forma for applications for Certificate of Approval, prospecting licence and mining lease. The State has the authority to specify the officer to whom the application should be made, other procedures to be followed by the applicant and the procedure for processing the application through the State administrative machinery.

There is considerable variation in the time taken in the various States to process an application ; even in the case of granting a Certificate of Approval, which requires little processing, times reported vary from one week to several months. In the case of a prospecting licence or mining lease (mineral concession) certain States process them in two months if Central Government approval is not necessary, while others frequently run over the nine months period specified by the MCR as the period beyond which the applications "shall be deemed to have been refused". This provision, however, is only for the purpose of the filing of a revision petition to the Central Government by the applicant, should he so desire. It does not mean that after the lapse of nine months the State Government cannot pass an order on the application.

There are, principally, two procedures for the filing of an application. In one, the application is made to a revenue officer or magistrate at the district or sub-divisional level. In the other, the application is made to a mining engineer, an official of the DMG, at one of the above levels. Certain investigations have to be done at the local level before the applications are sent up for decision. These include (not in all areas) clearance from a local revenue official with regard to the eligibility of the land for mineral exploitation (not near any public place such as temple, mosque, church, burial ground etc.), clearance from a forest officer that operations in the area will not result in unacceptable depletion of forest resources and from a mining officer that the area is not already leased out for exploitation of the same mineral, that it is free from encumbrance and that the area contains mineral in exploitable state and quantity. The time taken for obtaining these clearances vary widely, perhaps reflecting the priority assigned by the State to mineral exploitation.

In many States, Certificates of Approval, a pre-requisite for application for a mineral concession, are granted by a district level officer—revenue officer, magistrate or mining officer, as the case may be. In others, the certificate has to be granted at the State level.

Decisions on the grant of mineral concessions are taken only at the State level (with the exception mentioned below). The DMG often has authority to take decisions on applications involving revenue to the State up to a certain amount, above which the decision is taken at a higher level. In some States, for example Rajasthan, short term leases, of up to five years, and involving

revenue below a specified amount, can be granted by the District Mining Engineer.

Broadly, it would appear that procedures in which applications are made through an official of the DMG take less time in processing than those in which a revenue official or magistrate is in charge of piloting the application. However, it is reported that in Andhra Pradesh, where a Deputy Collector with certain special responsibilities in the development of mining and industry receives the application, processing is quite rapid.

3.5 The DMG is responsible for ascertaining that the production and grades reported by the mining lessee are correct, and computing the royalty and other revenue to be realised by the State. For this purpose, periodic inspections of the mines are carried out, production and sales figures examined, and stock and grades verified. Here again, differences are reported in the frequency and timeliness of the Inspector's visits, severity of inspection and the procedures required to resolve differences.

There are significant differences between the requirements in various States for verification of figures. In some States, for example Orissa, the mine owner must stack his production by grade, in stacks conforming to size specifications, for inspection by the mines Inspector before shipping. It is only after inspection, and granting of a permit by the District Mining Engineer on the recommendation of the Inspector, that the mineral can be sent out of the mine. Weighment is done at the rail-head.

Some States insist on the provision by the mine owner of a weighing machine at the mine, and all despatches must be weighed at the mine. Others permit weighment off-site, at the shipping point or a transfer point. There might be differences in the same State between procedures for different minerals. For example, whenever sales are through the public-sector Minerals and Metal Trading Corporation (MMTC), it is usual to have the weighing made at the rail-head. In several instances, checking of the grade is also done there.

In Gujarat, the grade analysis provided by the bauxite mine owner is usually accepted.

3.6 In many States the DMG has taken initiative in providing or arranging for inputs that would encourage faster and better exploitation. The DMG may have drilling machines for exploration, drilling equipment for blasting (in some operations, e.g. mica mines, blasting is a periodic rather than a continuous activity) and other equipment not needed continuously. Technical assistance is offered in the preparation and execution of mining plans.

3.7 When a lessee violates conditions attached to his lease, for example refuses entry or inspection rights to a Government Inspector or defaults in the payment

of royalty or other monies due to Government, the State is required to give notice, at the time of the first occurrence of the violation, requiring him to remedy the violation within a specified period. However, if the violation is not remedied, the State can terminate the lease. Mine owners consider this provision for termination in the case of even minor violations too onerous. As violations can occur even inadvertently, this is reported to impair seriously the prospects of a mine owner for securing financing from commercial or Government financing institutions. However, it may be stated that, both at the Centre and the States, officials have pointed out that there have been few cases of such termination. It is understood that the Centre is contemplating certain steps to remove this handicap to miners in securing financing.

3.8 State finance corporations, established for the purpose of accelerating economic activity in the State, tend to be less conservative than commercial banks in providing credit. However, usually these corporations do not give short term credit, of which mining is in need. With respect to long term financing for capital investment, there are other difficulties in financing mining ventures, as discussed in detail in a later Part.

3.9 Almost every State has set up an agency for exploitation in the public sector of minerals in the State. Usually these bodies are called Mineral Development Corporations. They take up major resources of the State with a view to exploiting them rapidly. States have made it a practice to reserve large areas for exploitation by the State-run organisations. Often the State agency does not have the resources to develop these areas in reasonable time. Private sector operators complain that, in addition to curtailing their scope greatly, locking up large areas defeats the objective of rapid development of the State's resources and improving its economy. In addition, when the State agency is interested in a mineral, the State often refuses to renew leases of other parties who are already operating in the mineral. Thereby, improvement and expansion of existing activity is discouraged. The survey showed that few State agencies can claim to be operating their leases with greater technical ability or with greater efficiency than the average private operator.

4. Geological Survey of India

4.1 Historical Background

4.1.1 The Geological Survey of India (GSI) is a survey and research organisation conducting both field surveys and fundamental and applied research. Although the Geological Survey was established as a regular Government Department only in 1856, there has been uninterrupted geological surveys in the country since March 1851 by the same organisation. An important addition to the cadre of the Department, in 1894, was the appointment of several mining officers. Early in 1902, the mining section was separated and in due course, became the Department of Mines. It was during 1903-1910, that the

GSI became a more prominent organisation when it was made responsible for advising the Government on policies relating to mineral concessions, including oil, in India and Burma. In the year 1942, the utilisation Branch was set up as a special wing of the survey to deal with the utilisation of the survey in time of war. During that very year the most valuable records, stores and laboratory equipment of the survey were dispersed to the various provinces owing to war-time evacuation of Calcutta, and the officers re-assigned to the new locations. These local centres later developed into the circle offices which are now established in different States. The GSI reached new land-marks in its expansion towards the end of 1944, when the Mineral Development, Engineering Geology and Ground-water circles were set up to cope with the increasing number of mineral investigations and problems relating to engineering geology and ground-water. In 1945, a new section for geophysics was started. A drilling section was also organised for sub-surface exploration and assessment of mineral deposits, and for planning their economic exploration. A Mineral Information Bureau was opened to disseminate mineral information in non-technical language and to cater to enquiries from industries and the public. In 1940, the GSI had a strength of only 25 technical officers. On account of large scale expansion of the GSI., this figure rose to 116 officers towards the end of 1947, 1376 in 1966 and 1438 in 1968-69.

Organisational set-up

4.2.1 The GSI is headed by the Director General whose headquarters is at Calcutta. To assist him in his work, there is one Deputy Director General at the headquarters. There are five more Deputy Director Generals each in charge of a Regional Office. For effective control of field operations, each region is further decentralised to a circle level, each circle headed by a Director. Every State of the Indian Union is provided with a Circle Office, that is to say that the work in a State is individually looked after by the GSI Circle Office. A chart showing the present organisational set-up of the GSI is at Appendix I.

4.2.2 The Director General, Deputy Directors General and Directors of Circles, besides supervision of technical programmes, attend to matters involving general administration as they are Administrative Heads of Offices.

4.3.1 Functions of the GSI

Entrusted with the responsibility of advising the Government on all geological matters including those on development of the country's mineral resources the main functions of the GSI include:

(a) Systematic geological mapping of the total land surface of India on suitable scales. This involves identification of rock types, plotting of the distri-

bution and attitude of rock types, collection of representative samples for various analyses, locating areas of possible mineral deposits, preparation of reports and maps,

(b) Preliminary and detailed mineral investigation for preparation of an inventory of available mineral resources including off-shore exploration for mineral resources.

(c) Systematic basin-wise geohydrological and water supply investigations for rational use of the country's underground water resources.

(d) Geotechnical investigation for dams, tunnels, power houses and flood control measures, studies on suitability of hill slopes for border roads and seismological studies.

(e) Fundamental research on various subdisciplines of the earth sciences.

(f) Publication of maps, journals, bulletins, etc. The latter include "Records" "Memoirs" "Bulletin Series A" (for mineral resources and economic geology), "Bulletin Series B" (covering topics on engineering geology, groundwater and geophysics), "Indian Minerals", and "Palaeontologia Indica.".

(g) Dissemination of information of geological and mineral interest to the Governments (both Central and State), public and private parties.

(h) Imparting field training to graduates, postgraduates and other technical and scientific personnel from GSI and similar organisations in the country.

4.4 Standard Norms of Working

4.4.1 A set of norms are fixed for different activities of work undertaken by GSI and for personnel employed in research etc. These norms are part of self-imposed disciplines and have to be treated as flexible. These are, however, adhered to as far as possible. The standard norms set for the different type of geological investigations are given below :

Systematic Mapping	—	380-400 sq. km per Officer/Season in normal terrain
		200-250 sq. km/Officer/Season in hilly terrain
		100-150 sq. km/Officer/season in larger scale.

Large Scale Mapping	—	20-25 sq. km/Officer as Airphoto's (2"=mile) 0.5 sq. km/Officer/season in plane table together with sampling, pitting etc. where needed.
Groundwater Survey	—	One Geologist will be able to cover about 1500 sq. km/season for only water table mapping.
Drilling	—	750 metres/drill/year
Mining	—	Major-750m. per unit/year and Minor-200-250m. per/unit/year.

As for the officers in the laboratories, there are no standard norms as such but their number is based on the work-load assessed for each research investigation to be taken up.

4.5 Geological Investigations and Programmes

4.5.1 Under geological investigations are covered (i) routine or normal survey works by GSI as already outlined earlier, and (ii) survey conducted in collaboration with foreign agencies. The latter includes projects like 'Operation Hardrock', with U. S. assistance, and 'Airborne Geophysical Surveys' with French and Russian Collaborations. The objectives of all these investigations and related mineral exploration programmes are :

(i) to provide the basic geological and mineral exploration data for different areas in the country to form the basis for planning mineral based industries and programmes of development in these areas, and

(ii) to perform detailed exploration in minerals and areas of critical importance to plan objectives ; detailed exploration tasks are also taken up on assignment by public and private sector agencies on payment.

Though continuous the mineral exploration process, for convenience, may be classified into two stages before actual exploitation is taken up viz. (i) the follow up or regional mineral assessment, and (ii) the detailed mineral assessment.

During the preliminary mineral assessment air borne, geophysical surveys, photogeological methods, regional geochemical surveys and regional mapping surveys are undertaken to delineate only wider zones or areas of interest for follow up surveys. The evidence gathered through the preliminary and follow up surveys provide data for the selection of projects for detailed exploration. During this last phase, the detailed geological, drilling and exploratory mining operations are being carried out on these projects to discover whether exploitation is economically feasible and if so, what are the best methods to be used.

4.5.2 The programmes of different investigations are drawn in advance by the Director General, GSI in consultation with other officers, taking into account priorities fixed from time to time and the funds available. Also taken into account are the programmes discussed at State Programming Boards which include representatives from State Departments, Geological Survey of India and the Planning Commission.

4.5.3 *Operation Hardrock*. The Government of India undertook 'Operation Hardrock' project in collaboration with the United States Agency for International Development (USAID) in July 1967. The main object of the project was to intensify and accelerate the location and discovery of exploitable base metal deposits of copper, lead, zinc, molybdenum, nickel etc., 'Operation Hardrock' envisaged air-borne geophysical surveys over a total area of 90,000 sq. km. in parts of Andhra Pradesh, Bihar, West Bengal and Rajasthan in order to locate zones for intensive ground exploration.

After a detailed evaluation of the aeroanomalies based on their magnetic and electro-magnetic characteristics and geological associations, 11,000 anomalies were selected for follow up by reconnaissance evaluation. About 3,000 anomalies have been covered, 10% of which seem to be promising areas. These are located as follows :

Rajasthan	:	Ajit Nagar, Fathepur, Singhara, Makri, Nalpura, Dedwas and Bhopal Sagar.
Bihar West Bengal	:	Chukru, Tamakhun, Porapahar, Jharia and Dharkula.
Andhra Pradesh	:	Papayapa'am, Ontimitta and Emaluru.

Drill holes located at Ajit Nagar, Fathepur, Singhara, Makri, Chukru, Tamakhun and Papayapalam have encountered zones of sulphide mineralisations with minor values of copper and in two cases of molybdenum. Further work is in progress at Ajit Nagar where a zone analysing 1.5 per cent copper was encounted. The drill hole at Papayapalam disclosed 56 cms. of lead sulphide mineralisation with minor copper sulphides.

The expenditure involved in the project is estimated at Rs. 52.28 million which include Rs. 34.38 million contractor's cost and Rs. 17.90 million as the cost of Government of India.

4.5.4 *French Programme*. It is now proposed that the Government of India may take help from the French for a combined electromagnetic, spectrometric and magnetic survey for covering about 99,250 sq. kms. in Mysore, (with some adjoining areas in Tamil Nadu and Andhra Pradesh), Gujarat, Rajasthan and Madhya Pradesh. The programme does not envisage ground follow up work and drilling. The estimated cost of the aerial survey will be about Rs. 39.2 million including Rs. 22.5 million in foreign exchange.

4.5.5 *USSR Programme.* It has also been decided to take Soviet assistance to undertake air-borne magnetometric survey over an area of 131,400 sq. kms. in Dandakaranya (Madhya Pradesh, Orissa and Andhra Pradesh) and Sambalpur —Bolangir (Madhya Pradesh and Orissa). Like the French Programme this collaboration is also restricted to air-borne survey. The cost is estimated to be Rs. 11,752,900/- including Rs. 7,886,000 (in equivalent roubles) in foreign exchange.

4.5.6 The GSI takes up detailed drilling programmes both as sponsored and non-sponsored projects. In case of non-sponsored projects, the GSI carries out detailed exploration, first, at its own cost. Once exploration is done to a certain extent, the area is given to public or private sector agencies for exploitation. Under the present principles of working of the GSI expenses incurred by it on exploration are to be fully reimbursed by the exploiting agencies. But the exploiting agencies feel that the GSI's charges are rather high. The agencies, at times, also feel that the drilling work done by the GSI is not exactly what is required by them. Hence for the mining purpose they would need further exploration planned according to their own requirements. For such reasons, they may not like to pay the entire amount GSI has asked for. Similarly, in case of assigned projects, the sponsors feel that the charges by the GSI are high. Consequently, a large amount is still awaiting realisation by the GSI (including realisation by Indian Bureau of Mines as its drilling wing, of late, has been merged with the GSI).

As per the information available it is understood that till 18th September, 1969, an amount of Rs. 8 million was due to be paid to the GSI and the IBM for prospecting and exploratory work done for some of the public sector corporations like National Coal Development Corporation, National Mineral Development Corporation, Hindustan Copper Ltd., Pyrites, Phosphates and Chemicals Ltd., and Cement Corporation of India. The non-payment of dues by these corporations is mainly on account of the fact that they found the charges to be rather high. It is, therefore, felt necessary to revise the schedule of charges as well as to finalise up to what extent the GSI should carry on prospecting and exploratory work (conducted at its own expense) and wherefrom the mineral exploiting agency should start to bear the expenses of detailed exploration. It is also understood that a committee has been set up to discuss and finalise such issues.

4.6 Achievements

4.6.1 By systematic geological mapping a total area of about 1425 thousand sq. km. had been covered by GSI till September, 1969. This comes to roughly 44 per cent of the total area of the country leaving a balance of 56 per cent (about 1843 thousand sq. km.), still to be covered. Of this remaining area 389 thousand sq. km. are covered by the alluvial plains of the Ganga and the Brahmputra and 967 thousand sq. km. by Deccan Traps. Therefore,

the area covering these two regions (about 1356 thousand sq. km.) is lowered in priority to be taken up in stages. It is proposed to cover 290 thousand sq. km. and 485 thousand sq. km. during the Fourth and Fifth Plan periods respectively leaving a gap of 34 per cent to be covered at the end of 1978-79.

5. Indian Bureau of Mines

5.1 The Indian Bureau of Mines (IBM) was set up in March, 1948 by the Government of India to work in close liaison with the various Ministries and Departments of the Central Government and to function primarily as an Advisory Body. The activities of the Bureau were rationalised during the Second Five Year Plan and the quantum of work and responsibility increased.

5.2 The primary function of the IBM is conservation and development of the mineral industry. Conservation and mines control, exploration including prospecting and drilling and technical co-ordination were the major activities of the Bureau. However, to avoid duplication of work of the Bureau with that of the GSI, the Government of India transferred the exploratory division to the GSI from January 1, 1966. Other activities of the IBM include work on ore dressing, beneficiation and quite recently offer of competent technical consultancy to the mining industry.

5.3 The IBM is at present organised into three technical and one administrative divisions. The three technical divisions, namely the Mining Control and Conservation of Minerals (MCCM) division, Ore Dreseing (OD) division and the Mineral Economics (ME) division directly relate to mining and the mining industry. The MCCM division inspects the mines, renders advice to the Central and State Governments of the exploration and exploitation of mineral resources and carries out research on different mining aspects. The activities of the OD division is limited to conducting laboratory and pilot plant studies for the improvement of grade and removal of objectionable constituents in the ore. Generally, the activities are commercially oriented. The ME division was started to render advice to the Government for grant of mineral concessions, amendment/promulgation of rules and regulations pertaining to the mining industry, collection of mineral statistics relating to production, stocks, etc., both in domestic and international fields, publication of statistics, bulletins and monographs and assisting the industry in marketing of minerals.

5.4 The IBM has been conducting for some time detailed regional studies to develop the mineral industry and conserve the valuable minerals. The major activities of the Regional Offices working under the Regional Controller include inspection of the mines, advice on the various aspects of mining and conducting regional studies. Mention could be made here of the studies being conducted in the mica fields for the location of mica bearing pegmatites.

5.5 The need for technical assistance and scientific development of mines and installation of modern mining techniques and practices is paramount. A decision to establish a consultancy unit was taken and work has been in progress for over a year now to establish and to offer technical consultancy to the mine-owners. The service which was started by the IBM on a rather hesitant note has found support among the bigger units and it is expected that the services are likely to expand to cover all the major aspects of mining inclusive of detailed exploration, preparation of mine plans, choice of mining techniques, and laboratory and pilot plant studies for ore dressing.

ORGANISATIONAL SET-UP OF GEOLOGICAL SURVEY OF INDIA

DIRECTOR GENERAL

Dy. Director General
Headquarters

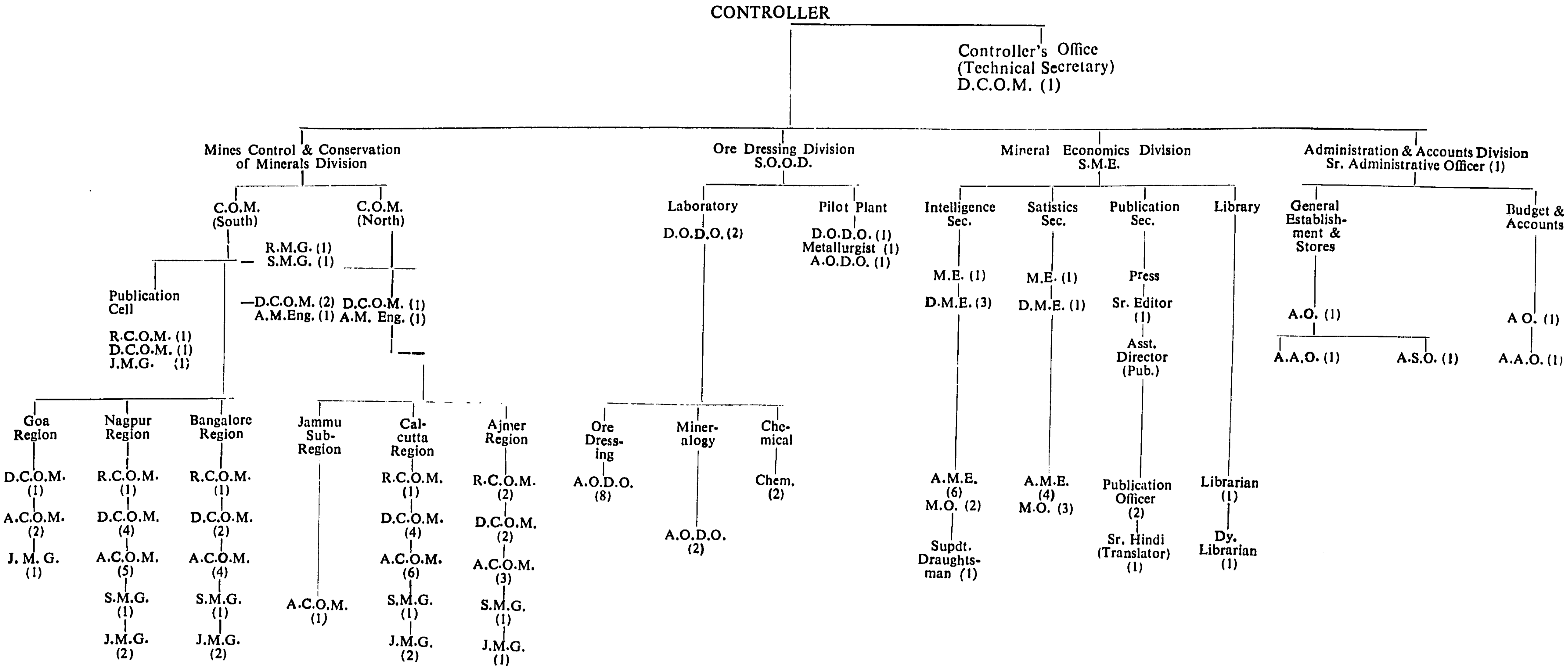
Dy. Director General Eastern Region	Dy. Director General Southern Region	Dy. Director General Central Region	Dy. Director General Western Region	Dy. Director General Northern Region
Assam Circle Bihar Circle Orissa Circle West Bengal Circle Nefa Circle	Andhra Circle Kerala Circle Madras Circle Mysore Circle Mineral Exploration	Madhya Pradesh Circle Maharashtra Circle	Gujarat Circle Rajasthan Circle Mineral Exploration	Punjab and Himachal Pradesh Circle Jammu/Kashmir Circle Uttar Pradesh Circle Himalayan Geology Division

- Engineering Geology
- Groundwater
- Geophysics
- Drilling
- Mining
- Petrological Laboratory
- Palaeontological Laboratory
- Chemical Laboratory
- Engineering & Transport
- Administration

- Coal Division
- Map Production Division
- Publication Division
- Planning and Training
- Field Training Research Unit
- Mining Division
- Drilling Division
- International Wing

- **Bhutan Circle** Nepal Wing of I.C.M.
- Geophysics Division
- Petrology Division
- Palaeontology Division
- Chemical Division
- Engineering & Transport
- Foreign Aid Scheme
- Stores
- Administration

ORGANISATIONAL SET-UP OF INDIAN BUREAU OF MINES (June 1969)



Controller of Mines	(C.O.M.)	2
Regional Controller of Mines	(R.C.O.M.)	5
Deputy Controller of Mines	(D.C.O.M.)	18
Asstt. Controller of Mines	(A.C.O M.)	21
Regional Mining Geologist	(R.M.G.)	1
Senior Mining Geologist	(S.M.G.)	5
Junior Mining Geologist	(J.M.G.)	9
Asstt. Mining Engineer	(A.M. Eng.)	2

Supdtg. Officer Ore Dressing	(S.O.O.D.)	1
Deputy Ore Dressing Officer	(D.O.D.O.)	3
Metallurgist		1
Asstt. Ore Dressing Officer	(A.O.D.O.)	11
Chemist	(Chem.)	2
Asstt. Research Officer	(A.R.O.)	3
Sr. Administrative Officer	(S.A.O.)	1
Administrative Officer	(A.O.)	2
Asstt. Administrative Officer	(A.A.O.)	1
Asstt. Store Officer	(A.S.O.)	1

Superintending Mineral Economist	(S.M.E.)	1
Mineral Economist	(M.E.)	2
Deputy Mineral Economist	(D.M.E.)	4
Asstt. Mineral Economist	(A.M.E.)	10
Senior Editor		1
Asstt. Director (Pub.)		1
Mineral Officer		5
Publication Officer		1
Librarian		1
Deputy Librarian		1
Superintending Draughtsman		1
Senior Hindi Translator		1

FIELD ORGANISATION OF THE DIRECTORATE GENERAL OF MINES SAFETY

- DIRECTOR-GENERAL
  - Dy. Director General
    - Director (N. Zone) (Dhanbad)
      - —3 Dy. Directors (Electrical)
      - —1 Dy. Director (Mechanical)
      - —1 Dy. Director (Vocational Training)
      - —1 Asstt. Director (Ind. Hygiene)
      - —1 Law Officer
      - 1 Jt. Director (Dhanbad-1)
        - 3 Deputy Directors.
      - 1 Jt. Director (Dhanbad-2)
        - 3 Deputy Directors.
      - 1 Jt. Director (Dhanbad-3)
        - 3 Deputy Directors.
    - Director (C. Zone) (Nagpur)
      - —1 Dy. Director (Vocational Training)
      - —2 Dy. Directors (Electrical)
      - —1 Asstt. Director (Ind. Hygiene)
      - 1 Jt. Director (Nagpur)
        - 3 Deputy Directors.
      - 1 Jt. Director (Shahdol)
        - 3 Deputy Directors.
    - 1 Jt. Director (Ajmer)
      - 4 Deputy Directors.
    - Director (S. E. Zone) (Ranchi)
      - —1 Dy. Director (Electrical)
      - —1 Dy. Director (Vocational Training)
      - —1 Asstt. Director (Ind. Hygiene)
      - 1 Jt. Director (Kodarma)
        - 1 Deputy Director
      - 1 Jt. Director (Chaibasa)
        - 2 Deputy Directors
      - 1 Jt. Director (Ranchi)
        - 3 Deputy Directors.
    - Director (S. Zone) (Oorgaum)
      - —2 Dy. Directors (Electrial)
      - —1 Dy. Director (Mechanical)
      - —1 Dy. Director (Vocational Training)
      - —1 Asstt. Director (Ind. Hygiene)
      - 1 Jt. Director (Goa)
        - 1 Deputy Director.
      - 1 Jt. Director (Oorgaum)
        - 3 Deputy Directors.
      - 1 Jt. Director (Hyderabad)
        - 3 Deputy. Directors.
    - Director (E. Zone) (Sitarampur)
      - —1 Dy. Director (Mechanical)
      - —3 Dy.Directors (Electrical)
      - —1 Dy. Director (Vocational Training)
      - —2 Dy.Directors (Law)
      - —1 Asstt. Director (Ind. Hygiene)
      - —1 Law Officer
      - 1 Jt. Director (Sitarampur-1)
        - 3 Deputy Directors.
      - 1 Jt. Director (Sitarampur-2)
        - 3 Deputy Directors.
      - 1 Jt. Director (Sitarampur-3)
        - 3 Deputy Directors.
      - 1 Jt. Director (Digboi)
        - 1 Deputy Director.

CHAPTER III—GENERAL LEGISLATION GOVERNING MINING

1. Partnership Act

1.1 The Partnership Act, 1932 is a Central Act. Under the Act, there is no restriction on the number of persons forming a partnership if such a business organisation has to be entered into, and all activities thereunder will be governed by the Indian Partnership Act. Partnerships in India may be either registered or unregistered. The Partnership Act does not provide for any particular form of the deed to be executed between any of the partners thereof. If the partnership is registered it is referred to as a registered firm of partnership. This will be taxed according to Annexure 'A' in the first instance. Thereafter each individual partner after having received his share will be taxed on his individual share according to the provisions of the Indian Income Tax Act, 1961 Annexure 'B').

1.2 If the partnership is unregistered, then the income of the partnership is taxed according to the share of each individual partner in accordance with Annexure 'A'. However, under the Indian Income Tax Act, 1961 an unregistered partnership may also be taxed at the same rate as a registered partnership, if it is so determined by the Income Tax Officer that more tax would be realisable then by taxing the income of the firm as an unregistered firm.

2. Classification of Companies

2.1 Incorporation, regulation and winding up of trading corporations is a Union subject and the Companies Act, 1956 (Act 1 of 1956) enacted by Parliament governs the formation, regulation and the working of companies in general. There are also other enactments governing specialised companies, such as banking and electricity companies. Apart from these, Parliament has also created some statutory corporations by special enactments ; but this practice is restricted to State undertakings only. To these bodies the provisions of the Companies Act may or not be made applicable.

Under the Act, the Central Government is given certain powers to regulate and control the working of companies and that power is exercised by the Government in the Ministry of Company Affairs. The Act also provides for the constitution of the Board of Company Law Administration by the Central Government and the Board is to exercise and discharge such powers and functions conferred on the Central Government by or under the Companies Act or any other law as may be delegated by that Government subject to the control of that Government. The Board is to consist of not more than 5 members, including the Chairman who is also to be appointed by the Central Covernment. The procedure of the Board is regulated by the Company Law Board (Procedure) Rules, 1964.

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2.2 Corporate Form (Private/Public). Companies are promoted, incorporated and registered in India under the Companies Act, 1956, either as a "Private Company" or as a "Public Company". The fundamental difference between the Private and Public Companies is that a Private Company by its Memorandum and Articles of Association (Statute or Charter) :

(a) Restricts the right of the shareholder to freely transfer his shares ;

(b) Limits the number of shareholders to 50 excluding employees ; and

(c) Prohibits any invitation to the general public to subscribe for any shares or debentures in the company.

A Public Company has not been defined under the Companies Act, 1956, but it means a Company which is not a Private Company. The minimum number of shareholders for the Companies to be registered are two in the case of Private Companies and seven in the case of Public Companies. A Private Company has the suffix Company Private Ltd. i.e. "Co. Pvt. Ltd." after its name and a Public Company has the suffix "Co. Ltd." after its name.

Companies under the Act can have the liability of their members (a) limited by shares, or (b) limited by guarantee, or (c) unlimited.

2.3 Another category of Companies with which the Companies Act deals separately is that of Government Companies. A Government Company is defined as a Company in which not less than 51% of the paid-up share capital is held by the Central Government or by any State Government or partly by the Central Government and partly by one or more State Governments and includes a Company which is a subsidiary of a Government Company as thus defined. Under the Companies Act the Companies are entirely governed by the Memorandum and Articles of Association which will function as a charter of the Company. The Memorandum and Articles of Association must be in accordance with the provisions of the Act. If any provision of the Memorandum and Articles of Association is violative of the Act, the provisions of the Act shall prevail. Articles of Association of the Company deal with, interalia, matters such as shareholders' rights, appointment of Directors, day to day business of the Company, etc.

2.4 "Company" under the Income Tax Act, 1961, covers two types of Companies :

(a) Indian Companies which are registered under the Companies Act of 1956 ;

(b) Foreign Companies :—

  (i) Any body corporate incorporated by or under the laws of a country outside India ; or

  (ii) Any institution, association or body which is or was assessable or was assessed as a company for any assessment year under the Indian

Income-Tax Act, 1922 (11 of 1922), or which is or was assessable or was assessed under the Income Tax Act, 1961, as a company for any assessment year commencing on or before the 1st day of April, 1970 ; or

(iii) Any institution, association or body, whether incorporated or not and whether Indian or non-Indian, which is declared by general or special order of the Central Board of Direct Taxes, New Delhi to be a Company ;

Provided that such institution, association or body shall be deemed to be a company only for such assessment year or assessment years (whether commencing before the 1st day of April 1971, or on or after that date) as may be specified in the declaration.

2.5 A Company under the Income Tax Act, 1961, could be :

(i) a Company in which the public are substantially interested,

(ii) a Company in which the public are not substantially interested, or

(iii) any institution, association or body which is declared by the Central Board of Direct Taxes to be a Company (Introduced by Finance Act, 1971).

Under the following circumstances, a Company is said to be a Company in which the public are substantially interested :

A. If it is a Company :—

(a) Owned by

(i) The Government ; or

(ii) The Reserve Bank of India ;

OR

(b) In which not less than 40% of the shares are held (singly or jointly) by :

(i) the Government

(ii) Reserve Bank of India

(iii) Corporation owned by Reserve Bank of India

OR

(c) If it is not a Private Company as defined in the Companies Act, 1956 ;

and Shares in the Company (not being shares having a right to a fixed dividend with or without right in further participation in the

profits) were, as on the last day of the previous year, listed in a recognised Stock Exchange in accordance with the Securities Contracts (Regulation) Act, 1956, and rules thereunder.

B. (a) If it is not a Private Company as defined in the Companies Act, 1956, and

(1) Its equity shares with not less than 50% (40% in the case of "Industrial Company") voting powers were held throughout the previous year by :—

(i) The Government ; or

(ii) A corporation established by a Central, State or Provincial Act ; or

(iii) A Company in which the public are substantially interested ; or

(iv) A wholly owned subsidiary of a Company in which the public are substantially interested ;

(v) The general public ; and

(2) The equity shares were freely transferable by the holder to the general public ; and

(3) The shares of the Company with 50% (60% in the case of "Industrial Company") voting power were not at an time during the previous year controlled or held by less than 6 persons ; and

(4) The affairs of the Company were not at any time controlled by less than 6 persons.

The difference in tax rates as applicable to these Companies is as per Annexure 'A'.

2.6 "Domestic Company" means :

(a) Indian Company ;

OR

(b) Any other Company,

which in respect of its income liable to income tax under the Income Tax Act has made the following prescribed arrangement for the declaration and payment of dividend within India :

(i) The share register of the Company for all the share-holders has been regularly maintained at the principal place of business in India ;

(ii) The general meeting for passing the accounts of the previous year for declaring the dividend has been held within India ;

(iii) The dividend when declared is payable to all the shareholders within India.

2.7 A "Foreign Company" means a Campany which is not a Domestic Company or any other institution or association which is so declared by the Central Board of Direct Taxes, New Delhi.

2.8 An "Industrial Company" means a Company which is mainly engaged in the bussiness of generation or distribution of electricity or any other form of power or in construction of ships or in the manufacture or processing of goods or in mining. A Company shall be deemed to be mainly engaged in the said business if the income attributable to any one of the aforesaid activities is not less than 51% of its total income (before making any deduction under Chapter VIA of the Income Tax Act, 1961, such as 6% investment rebate, and 5% profit rebate if it is a priority industry).

2.9 "Priority Industry" means the business carried on by an Industrial Company in any one or more of the articles or things specified in the list in the Sixth Schedule to the Income Tax Act, 1961 ; among these are iron, copper, lead, zinc and manganese ; the other minerals under survey are not included in this Schedule therefore an Industrial Company engaged in the mining of the other minerals under survey shall not be entitled to the 5% profit rebate. Mining machinery has been included.

2.10 An "Indian Company" means a Company formed and registered under the Companies Act, 1956 (1 of 1956) and includes :

(i) a Company formed and registered under any law relating to companies formerly in force in any part of India (other than the State of Jammu & Kashmir) :

(ii) in the case of the State of Jammu and Kashmir, a Company formed and registered under any law for the time being in force in that State, provided that the registered office of the Company in all cases is in India ;

(iii) in the case of any of the Union Territories of Dadar and Nagar Haveli, Goa, Daman and Diu, and Pondicherry, a Company formed and registered under any law for the time being in force in that Union Territory.

3. The Income Tax Act, 1961

3.1 The Income Tax Act, 1961 is an act of Parliament. It is a comprehensive piece of legislation providing for the levy, computation of income, assessment, collection and recovery of income tax, and the appointment, powers and responsibilities of the various authorities under the Act, the imposition of penalties for offences

under the Act and such other matters like annuity deposits and tax credit certificates.

'Total income' for the purposes of the Act includes profits and gains, dividends, the value of any benefit or perquisities, whether convertible into money or not, obtained from a company by a Director or a person who has substantial interest in the company.

The Act enumerates six heads of income, viz. (a) Salaries, (b), Interest on securities, (c) Income from house property, (d) Profits and gains of business and profession, (e) Capital gains and (f) Income from other sources. The Act deals with each head separately and provides for various exemptions and deductions that can be made in computing the income under each of the heads separately. The Act specifies the various losses that can be carried forward from one year to another.

The Act provides for the charge of income-tax at the rates imposed for any particular year called the 'assessment year' on the total income of the 'previous year'. 'Assessment year' means the period of twelve months commencing on the 1st April every year. The previous year is generally the year immediately preceeding the assessment year. If the accounts are maintained for different period, the 'previous year' at the option of the tax payer, subject to the limitations imposed by the Act, will be the accounting year ending in the immediately preceeding year to the assessment year.

The taxable entities (assessees) under the Act are classified into (i) companies ; (ii) individuals ; (iii) Hindu undivided families ; (iv) local authorities ; (v) firms ; (vi) association of persons, or a body of individuals ; (vii) any other juridical person not covered by the above. A mine owner or operator would fall into one of these categories according to his method of operation.

For the purposes of taxation, assessees are divided into residents, non-residents, and those not ordinarily resident : the liability to tax varies accordingly, under the Act.

Elaborate rules are made under the Act known as the Income Tax Rules, 1962. These Rules provide the various details for the working of the Act.

Changes in the Act are introduced whenever necessary by the Central Government in the Finance Act each year at the time of the Budget Session of Parliament. The Rules are also amended from time to time.

3.2 *The Companies (Profits) Surtax Act, 1964* (Act 7 of 1964), as its preamble reads, imposes a special tax on the profits of certain companies. Section 4 of the Act charges every company for every assessment year commencing from 1st April, 1964 a tax described as surtax, in respect of so much of its chargeable profits of the previous year or years as exceed the statutory deduction, at the rate or rates specified in the Third Schedule to the Act. 'Chargeable Profits'

means the total income as computed under the Income Tax Act, 1961 and adjusted in accordance with the provisions of the First Schedule to the Act.

3.3 *Individual Taxation.* Individuals are subject to a graduated income tax on a slab basis starting from a basic taxable limit of Rs. 5000/- at the minimum rate of 5.5 % going upto the maximum tax rate of 93.5 % (Annexure 'B'). The basic rates are the same for residents, those resident but not ordinarily resident and non-residents except that in the case of non-residents, no minimum taxable limit shall be applicable.

3.4 *Pay Roll Taxes and Employee Benefits.* The employees of an "Indian Ltd, Company", both Indian and foreign personnel, are assessable to tax under the Indian Income Tax Act, 1961. Their tax liability is determined by their residence status and the source of income.

3.4.1. Under the Income Tax Act, 1961, there are three types of residences :

(1) Resident and ordinarily resident (Fully Resident)

(2) Resident but not ordinarily resident (Semi Resident)

(3) Non-Resident.

This distinction is made once for the peried of each year on the basis of residence in India.

A person is *non-resident* if he does not satisfy any of the following conditions in the previous year:

(a) Does not stay in India in the previous year for more than 182 days or more;

(b) Does not maintain a dwelling place in India for 182 days or more and has not been in India for more then 30 days in that year;

(c) Does not stay for an aggregate of 365 days or more during the preceeding 4 years and is not present in India during the previous year for 60 days or more.

A person is said to be *resident but not ordinarily resident* if he satisfies any one of the conditions mentioned in (a) above.

A person who is resident but not ordinarily resident shall be a *resident and ordinarily resident* if he satisfies the following two additional cumulative conditions :

(a) He has been in India for 730 days or more in 7 previous years ; and of ten years.

(b) He has been resident in India in nine out of ten years.

Income is divided into the following classes for the purposes of determining liability to taxation on the basis of residence :—

(1) Income received or deemed to be received in India.

(2) Income which accrues or arises, or is deemed to accrue or arise in India.

(3) Income accruing or arising outside India.

(4) Income accruing or arising outside India, which is derived from a business controlled in or profession set up in India.

3.4.2 *Income of a "Resident and Ordinarily Resident"* shall include items from 1 to 4 and foreign income shall also be included in the taxable income.

Income of a non-resident shall include items 1 and 2; foreign income shall not be included in his total income.

Income of resident but not ordinarily resident shall include items 1, 2 and 4 ; foreign income shall be included in his total income only if it arises from a business controlled in or profession set up in India.

Most of the foreign managerial and technical personnel working in India shall not be liable for Indian Income Tax on income arising outside India as in most cases their service in India will not exceed ten years.

However, compensation for services of an employee of a foreign enterprise who is not a citizen of India, is exempt from tax provided the following conditions are fulfilled :

(1) The foreign enterprise is not engaged in trade or business in India.

(2) The individual does not stay in India for more than 90 days in a year.

(3) The compensation is not deductible from the income of the employer chargeable to tax in India.

3.4.3 Besides the deductions and concessions allowable under the Income Tax Act, 1961, such as expenses on purchase of books, life insurance premiums, rent and conveyance allowances, payments of bonus and Provident Fund in other enactments applicable to all salaried employees, a foreign employee shall be entitled to the following deductions :

(i) The value of any free or concessional passage received by such foreign employee from his employer for himself, his wife and children in connection with his proceeding on home leave out of India, such payment shall not be included in his total income ;

(ii) the foreign employee shall be entitled to a deduction from total income at

the rate of Rs. 1500/- for one child and Rs. 3000/- for more than one child provided :

(a) the amount is spent for the full time education of his child ;

(b) the child should be wholly or mainly dependent on him ;

(c) the child should not be more than 21 years of age ;

(d) the child should be studying at a University, College or School or other educational institution situated outside India.

3.4.4 *Technicians.* The definition of the term "technician" under Income Tax Act, 1961, has been changed so as to exclude person having specialised knowledge and experience in industrial and business management techniques or in distribution of electricity or in any other form or power or in poultry farming.

'Technician' under the new definition means a person who has specialised knowledge and experience in :

(i) constructional or manufacturing operations, or in mining or in generation of electricity or any other form of power; or

(ii) agriculture, animal husbandry, dairy farming, deep sea fishing or ship building.

Provided such person is employed in India in a capacity in which his specialised knowledge and experience in the spheres stated above is actually utilised.

3.4.5 A foreign technician entering employment in India *on or after* 1st April, 1971 shall be eligible for the following tax exemptions :

(i) The remuneration of the technician for a period of 24 months from the date of his arrival in India shall be exempt from tax subject to a maximum of Rs. 4000 per month. Remuneration includes all payments including those chargeable under the head 'salaries' whether due or paid. The employer may pay the tax on the excess of the technician's remuneration of Rs. 4000 per month, for the said 24 months and the amount of tax paid by the employer on behalf of the employee shall not be charged to tax as a perquisite. Further, if the technician continues in the employment in India after the expiry of 24 months with the approval of the Central Government obtained before the 1st day of October of the relevant assessment year, the employer may pay tax on such remuneration for a maximum period of 24 months. Such payment of tax by the employer on behalf of the employee shall not be taxed as a perquisite in the assessment of technician. It may also be commented that remuneration chargeable under the head "salaries" includes salaries paid in India or abroad so long as the services are rendered in India. The tax exemption as stated above is available provided :

(1) the foreign individual renders services as a technician in the employment of the Government or a local authority, corporation or approved institution for scientific research or in any business carried on in India,

(2) the foreign individual was not resident in India in any of the four financial years immediately preceding the financial year in which he arrives in India. and

(3) the application to Central Government for approval of his contract for services is either made befor the commencement of his services or within 6 months of such commencement.

3.5 *Incentives and Concessions.* Private and Public Companies will hereinafter be referred to as Indian Ltd. Cos., as these incentives are equally applicable to Indian Private and Public Companies.

3.5.1 The "Indian Ltd. Company" shall be entitled to a rebate of 5% from the profits derived by it from a *priority industry*. The rebate shall be allowed in each year and shall be deducted from the profits of the company for the purposes of calculation of taxable profits. However, no rebate shall be allowed if the company is a company in which the public are substantially interested and its gross total income is Rs. 50,000/- or less.

3.5.2 *Investment Rebate.* (Deduction from Profits). The "Indian Ltd. Company" being an industrial undertaking shall be allowed an investment rebate of 6% per annum of capital employed by it in the industrial undertaking for 5 years. The capital employed is calculated in the prescribed manner, which simply stated means the net worth, less long-term borrowings and debentures. of the company in that year. The investment rebate is allowed to be deducted from the total income for the purposes of calculation of taxable income. If the profits are not sufficient in a year to take the full benefit of the investment rebate the deficiency is allowed to be carried forward to 7 assessment years from the initial assessment year for the purposes of set off in these years.

No tax shall be payable by a shareholder on the dividends received by it from a company out of the profits on which it is entitled to investment rebate of 6%.

3.5.3 *Deductions from Income of Intercorporate Dividends.* Deductions in the computation of the total income of the shareholders (company) of the "Indian Ltd. Company" shall be allowed in the following cases :

Foreign (Shareholder) Company :—

(a) Dividends received from "Indian Ltd. Company" if it is a Company in which the public are not substantially interested and it is engaged in a priority industry ... 80 % of such dividends

(b) Dividends received from "Indian Ltd. Company" if it is a Company in which the public are substantially interested. ... 65% of such dividends.

Domestic (Shareholder) Company

Dividends received from "Indian Ltd. Company" 60% of such dividends.

With effect from April 1, 1972 the deduction in relation to a foreign Company which holds shares in the "Indian Ltd. Company" will be reduced to 65%.

3.5.4 *Depreciation of Assets.* The "Indian Ltd. Company" shall be entitled to the following rates of depreciation on the plant and machinery used in the mines. The depreciation shall be calculated on the written down value and not on the straight line method, and no extra shift allowance shall be allowed even if the "Indian Ltd. Company" works on double or triple shift.

3.5.5 The rates of depreciation allowed on various items of plant, machinery and structures used in mining are as follows (in most cases there has been an increase in the rate in 1970) :

1.	(a)	Surface and underground machinery (except electrical machinery), head gear, moving parts and rails	15%
	(b)	Ropeway structures-carriers	
2.	(a)	Portable underground machinery and earth-moving machinery used in open cast mining	30%
	(b)	Motor lorries and motor tractors	
	(c)	Ropeway structures-ropeway ropes, trestle sheaves and connected parts	
3.	(a)	Electrical machinery	10%
	(b)	Locomotives, rolling stock	
	(c)	Boilers and head gears (excluding moving parts)	
	(d)	Tramways on the surface	
	(e)	Shafts and inclines	
	(f)	Ropeway structures—	
		(i) trestle and station steelwork	
		(ii) driving and tension gearing	
4.	(a)	Tubs, winding ropes, haulage ropes and sand stowing pipes	100% (i.e. allowed as revenue expenditure)
	(b)	Safety lamps	

It may be pointed out that

(a) there is no provision in the Income Tax Act, 1961, or in its Rules for the grant of depletion allowance in the mining industry, but it is negotiable with the Government of India ;

(b) amortisation of exploration and mine development expenditures are allowed, following the enactment of the Taxation Law (Amendment) Act, 1970, and the allowance due to this is discussed in 3.5.9 below.

3.5.6 *Development Rebate.* Over and above the depreciation on assets, the "Indian Ltd. Company" shall be allowed a deduction of development rebate equivalent to the following percentage of the cost of new plant and machinery installed by it :

(a) 35% in the case of iron ore, manganese or bauxite mines, and 20% in other cases if installed before 1st April, 1970 ;

(b) 25% in the case of iron ore, manganese or bauxite mines, and 15% in other cases if installed after 31st March, 1970.

Development Rebate is also allowed at the rate of 10% of the cost of second hand plant and machinery imported from abroad under prescribed conditions.

This rebate will cease to be allowed with effect from 1.4.74 as per the Finance Act, 1971.

The "Indian Ltd. Company" shall credit out of its profits 75% of the amount of development rebate to a separate specific reserve which shall not be utilised for 8 years by the "Indian Ltd. Company" for the purpose of :

(a) distribution as dividend ;

(b) remittance outside India as profits or creation of any asset outside India.

Moreover, such assets shall not be sold or otherwise transferred before the expiry of 8 years from the end of the previous year when such assets were installed except under certain circumstances when such sale or transfer is permitted by the Income Tax Act, 1961. However, the "Indian Ltd. Company" shall be entitled to declare dividend out of 25% of the Development Rebate in the year of installation when reserve was created and the balance of 75% of rebate at the expiry of 8 years.

3.5.7 *Export Markets Development Allowance.* A domestic company is entitled to deduct one and one-third times the amount of expenditure (if it is revenue expenditure in nature) incurred on development outside India in respect of its goods, services or facilities, expenditure for obtaining information regarding

markets outside India for such goods, expenditure incurred outside India for distribution, supply or provision outside India for such goods or facilities, maintenance of branches, submission of tenders, providing samples or technical information, travelling for promotion outside India, etc.

3.5.8 *Allowance on patent rights.* Expenditure on acquisition of patent rights is allowed to be amortised in the course of 14 years, subject to certain conditions and adjustments.

3.5.9 *Amortisation of preliminary expenses.* This is available only to Indian Companies. Preliminary expenses are allowed to be amortised in the course of 11 years.

3.5.10 *Deduction for prospecting expenses.* This allowance also is available only to an Indian Company which is engaged in any operation relating to prospecting for or extraction or production of any minerals. The allowance will not be available for capital expenditure such as acquisition of the site of the source of minerals or of the deposits or of any building, plant, machinery or furniture. If such a company incurs revenue expenditure during the year of commercial production, or in one or more of the four years immediately preceding that year on any operations relating to prospecting for any mineral or associated group of minerals specified in Part A or Part B of the Seventh Schedule of the Taxation Law (Amendment) Act, 1970, or the development of a mine or any natural deposit of any such mineral or group of associated minerals, then the company is entitled to spread out that expenditure during the ten previous years beginning with the year of commercial production and is entitled to deduction of 1/10th of such expenditure for each year.

3.5.11 *Tax Credit Certificate.* Chapter XXII B of the Income Tax Act, 1961, deals with the scheme of tax credit certificates in the following cases :

(a) Payments in respect of eligible issue of capital ;

(b) Shifting of industrial undertakings from urban areas ;

(c) Companies engaged in the manufacture of priority articles ;

(d) Exports ;

(e) Increased production of goods.

Since some of these are not applicable to the "Indian Ltd. Company" and in some cases these schemes are applicable only upto the financial year ending 31st March, 1970, these have not been dealt with at length.

3.6 The "*Indian Ltd. Company*" is taxed under the Indian Income Tax Act, 1961 as set out below :

3.6.1 The basic Company tax on income (other than dividends) as applicable to

"Indian Ltd. Company" shall vary from 45% to 65% depending on whether it is a Company in which the public are substantially interested or not.

3.6.2 *Income tax on dividend income.* If the "Indian Ltd. Company" receives any part of its income by way of dividend from another domestic company, it shall be given a rebate of 60% of such dividend income and on the balance, it shall suffer tax as per rates in Annexure "A" whether it is a Company in which the public are substantially interested or not. Similarly if the "Indian Ltd. Company" has been allotted shares in a foreign Company in lieu of patents, secret formula or process, information concerning industry, commercial or scientific knowledge, technical services rendered, it shall be allowed a rebate of the whole of such income and it shall have to pay tax on the balance amount only.

3.6.3 *Tax on royalty or fees received from foreign companies.* If any royalty or fees for rendering technical services is received by the "Indian Ltd. Company" from a foreign Company, it shall be allowed a rebate of the whole of such income for the purposes of calculation of tax liability.

3.6.4 *Deduction in the case of an Indian company in respect of royalties, etc., received from any concern in India* :—

(a) Where the gross total income of an assessee being an Indian company includes any income by way of royalty, commission, fees, or any other payment (not being income chargeable under the head "Capital gains") received by it from any person carrying on a business in India in consideration for :—

(i) the provision of technical know-how which is likely to assist in the manufacture or processing of goods or materials, or in the installation or erection of machinery or plant for such manufacture or processing, or in the working of a mine, oil well or other source of mineral deposits, or in the search for, or discovery or testing of, mineral deposits or the winning of access to them, or in carrying out any operation relating to agriculture, animal husbandry, dairy or poultry farming, forestry or fishing, or

(ii) rendering services in connection with the provision of such technical know-how, under an agreement entered into by the assessee with such person on or after the 1st day of April, 1969, and approved by the Central Government in this behalf, there shall be allowed, a deduction from such income of an amount equal to 40%, thereof, in computing the total income of the assessee :

Provided that the application for such approval is made to the Central Government before the 1st day of October of the relevant assessment year.

(b) For the purposes of this deduction "provision of technical know-how" means:

(i) the transfer of all or any rights (including the granting of a licence) in respect of a patent, invention, model, design, secret formula or process or similar property ;

(ii) the imparting of any information concerning the working of, or the use of, a patent, invention, model, design, secret formula or process or similar property ;

(iii) the use of any patent, invention, model, design, secret formula or process or similar property ;

(iv) the imparting of any information concerning industrial, commercial or scientific knowledge, experience or skill.

3.6.5 *The Companies (Profits) Surtax.* The "Indian Ltd. Company" shall be liable to pay Surtax under the Companies (Profits) Surtax Act, 1964, if the chargeable profits made by it as computed under the First Schedule to the Act exceed the amount of statutory deduction (10% of capital base or Rs. 200,000/- whichever is more as computed in the Second Schedule to the said Act). Surtax shall be charged on the amount by which the chargeable profits exceed the amount of the statutory deduction at the following rates :

(a) 25% on so much of the chargeable amount as does not exceed 5% of the amount of capital as computed in accordance with the Second Schedule.

(b) 30% on the balance if any, of the chargeable amount.

3.6.6 *Capital Gains Tax.* Any profit made by the "Indian Ltd. Company" on the sale of a capital asset which is a long term gain (Capital asset held for more than 12 months immediately preceding the date of its transfer) shall be liable for capital gains tax at the following rates :

(a) 40% where the long term capital gains arise as a result of transfer of buildings or lands ;

(b) 30% where the long term capital gains arise as a result of transfer of capital assets other than buildings and lands.

With effect from April 1, 1972 the afore-mentioned period of 12 months shall be increased to 24 months and the rate in (a) above shall be raised to 45% and the rate in (b) above shall be raised to 35%. Short term capital gains shall suffer tax at the rates applicable as on any other income.

3.7 The "Foreign Company" is taxed under the Indian Income Tax Act, 1961 as set out below.

3.7.1 Income Tax payable by a Foreign Company shall vary with the type of income it earns from its operation in India. The rates of income tax shall be as under :

Type of Income	Rate of Income Tax
(i) Dividends received from a Domestic, Company.	24.5%

(ii)	Royalty	50%
(iii)	Fees for rendering technical service	50%
(iv)	Any other income	70%

3.7.2 A Foreign Company is not liable to pay any Company Dividend Tax on the profits declared as dividend to its foreign shareholders.

3.7.3 A Foreign Company shall be liable to Companies (Profits) Surtax only on the chargeable profits like any other Indian Company except that the following income shall not be included in chargeable profits :

(a) Income by way of royalties received from Government or a Local Authority or any Indian Concern ;

(b) Income by way of interest or fees for rendering technical services received from Government or Local Authority or any Indian concern ;

(c) Income by way of dividends from an Indian Domestic Company.

3.7.4 A Foreign Company shall be liable to Capital Gains Tax on long term capital gains like any Indian Company (Annexure 'C').

4. Gift Tax

4.1 The Gift Tax Act, 1958 is an act of Parliament and provides for the levy of tax on gifts of any nature whatsoever, made by individuals, companies, firms and associations of persons. Gift Tax shall be payable by foreigners as well as by Foreign Companies on all gifts made by them in a year subject to the following limitations :

(1) No gift tax shall be paid for gifts upto Rs. 5,000/-

(2) No tax shall be levied on gifts of immovable properties situated outside India.

(3) No tax is levied on gifts of movable property situated outside India in case of :

(a) foreign citizen ever resident in India ;

(b) foreign companies unless the Company is resident in India.

5. Estate Duty

5.1 The Estate Duty Act, 1953 (Act 34 of 1953) is an act of Parliament and provides for the levy of estate duty or death duty on the devolution of property upon the death of an individual.

Besides the general exemption of Rs. 50,000/- and other specific exemptions, immoveable properties outside India are exempt from tax whether the deceased was an Indian citizen or foreigner and moveable properties situated outside India are also excluded in the case of foreigners. But all properties (unless otherwise exempted) situated in India are subject to estate duty in case of foreign citizens whether resident or non-resident.

5.2 A foreign company is required to pay estate duty with respect to a deceased shareholder and debenture holder if the company has been a resident for income-tax purposes in two out of three assessment years preceding the shareholder's or debenture holder's death. The duty is payable by the company itself at a flat rate of $7\frac{1}{2}\%$ on the market value of the shares or debentures if the market value exceeds Rs. 5,000/-.

6. Excise Duty

6.1 The Central Excise and Salt Act 1944 (Act 1 of 1944) is an act of Parliament dealing with duties of excise on goods manufactured or produced in India excepting tobacco, etc. Manufacture is defined to include any process incidental or ancillary to the completion of a manufactured product. Excisable goods are goods specified in the First Schedule to the Act as being subject to duty of excise and include salt, and the excise duty is to be levied and collected at the rates fixed in that Schedule.

The duty is leviable ad valorem on any article chargeable with the duty. The value of the article chargeable with the duty is the wholesale cash price for which it is sold or is capable of being sold at the time of the removal of the article, and where such price is not ascertainable, the price at which an article of the like kind and quality is sold or is capable of being sold at the time of the removal of the article.

6.2 The Act also empowers the Central Government to introduce a licensing system and provides that no person shall, except under the authority and in accordance with the terms and conditions of the licence granted under the Act, engage in (a) the production or manufacture or any process of the production or manufacture of any specified goods included in the First Schedule or of any specified component parts or ingredients of such goods or of specified containers of such goods or, (b) the wholesale purchase or sale (whether on his own account or as a broker or commission agent) or the storage of any specified goods included in the First Schedule. The Act also authorises the Central Government to apply any of the provisions of the Sea Customs Act, 1878 relating to levy and exemptions with due modification and alterations.

6.3 The Central Excise Rules, 1940 are the rules made under the Act. These Rules provide for the procedure for assessment and recovery of the Excise Duty, and the procedure to be followed for entry, search, seizure and investigation and for imposition of penalties under the Act.

7. The Customs Duty

7.1 The Indian Tariff Act, 1934 (Act 32 of 1934) is an act of Parliament which provides for the levy of customs duties. After the enactment by Parliament of the Customs Act, 1962 (Act 52 of 1962) the two Acts are to be read together for the purpose of levy of customs duty. The rates at which duties of customs shall be levied under the Customs Act, 1962 are specified in the First and Second Schedules of the Indian Tariff Act. The Customs Act, 1962 is a comprehensive enactment which provides in detail for all matters relating to customs including the officers of customs, the appointment of customs ports, air ports, warehousing stations, etc.

The Act also empowers the Central Government to prohibit importation or exportation of goods.

7 2 Under the Customs Act the value of the goods is deemed to be the price at which such or like goods are ordinarily sold or offered for sale for delivery at the time and place of importation or exportation as the case may be in the course of international trade where the seller and buyer have no interest in the business of each other and the price is the sole consideration for the sale or offer for sale ; and where such price is not ascertainable, the closest assertainable equivalent thereof determined in accordance with the rules made under the Act for this purpose. However, the Central Government is given the power to fix tariff values for any class of imported goods or exported goods having regard to the trend of value of such goods and in such cases the duty is chargeable with reference to such tariff value.

Customs duty is levied on machinery and equipment imported for the purposes of a mining project or a project for exploration of minerals at 40% ad volerum basis.

7.3 The Act also provides for drawback of import duty on re-export of the duty paid goods up to 98% under circumstances specified.

7.4 The Central Government and the Central Board of Excise and Customs are given the power to make rules and regulations under the Act for the purpose of carrying out the purposes of the Act, etc.

8. Sales Tax

8.1 The Central Sales Tax Act, 1956 is an act of Parliament. Inter-State sales are taxed under the said Central Sales Tax Act. The Act lays down various tests for deciding when a sale or purchase of goods is in the course of inter-State trade or commerce, when the same is deemed to take place outside a State, and when the same is deemed to take place outside a port. It imposes the liability to pay tax on the dealer.

'Dealer' is defined as any person who carries on the business of buying or selling goods ; every dealer is liable to pay tax on all sales of goods which attract the tax, effected by him in the course of inter-State trade or commerce during any year and every such dealer is required to register under the Act and obtain a certificate of registration. The rate of tax is collected on the turnover, that is the aggregate of sale price received and receivable by the dealer in respect of the sales as described above during the specified periods at specified percentages.

8.2 The rate of tax is 3% of the turnover when the sales are made to the Government of any goods, or to a registered dealer other than the Government of specified goods. These goods are of the class or classes specified in the certificate of registration of the registered dealer purchasing the goods as being intended for resale by him or subject to any rules made by the Central Government in this behalf, for use by him in the manufacture or processing of goods for sale or in mining or in the generation or distribution of electricity or any other form of power, etc. The Government of India has indicated the following as the specified goods referred to above in relation to the following among other industries :

A. Copper—all progress from ore-smelting to the manufacture of final products ready for use.

B. Copper material—1. ore, 2. scrap, 3. ingots, slabs, billets, etc. 4. sheets and strips, 5. rods and bars, 6. other copper materials.

C. Brass materials —1. scrap, 2. sheets and strips, 3. discs and circles, 4. rods and bars.

D. Basic materials other than aluminium, copper and brass materials—1. tin, 2. zinc, 3. lead, 4. steel. 5. others, if any.

E. Chemical—1. carbon, 2. caustic soda, 3. other chemicals.

F. Other materials including e.g. belts, spare parts.

Mining

1. Fuels—1. oil, 2. others.

2. Electricity (for lighting and heating).

3. Lubricating materials.

4. Timber.

5. Iron and steel goods (not classed 'iron and steel' within the meaning of Section 14 of the Central Sales Tax Act.)

6. Electrical goods.

7. Explosives—1. gun-podwer, 2. saltpetre, 3. sulphur, 4. catridge paper, 5. safety fuses, 6. gelignite, 7. detonators, 8. other explosives.
8. Construction materials—1. cement, 2. asbestos, 3. zinc sheets, etc. 4. tiles, 5. paints and varnishes, 6. others.
9. Chemicals.
10. Other articles.

8.3 It is to be noted that in order to avail of the lesser percentage of tax, viz. 3% as in the case of sale to the Government of any goods and sale to a registered dealer other than the Government of specified goods referred to above, a duly filled declaration form has to be furnished to the authorities. It is also to be noted that Section 6 provides that second sales of specified goods are not taxed under the circumstances specified therein.

8.4 All other goods are classified into what are called 'declared goods' and goods other than declared goods. "Declared goods" means goods declared as of special importance in inter-State trade or commerce and they are enumerated in Section 14 of the Act. None of the minerals under survey are classified as such.

In the case of goods other than declared goods, the tax is calculated at the rate of 10% of the turnover or at the rate applicable to the sale or purchase of such goods inside the respective States, whichever is higher.

8.5 Each State has its own Sales Tax Act for taxing intra-State sales of goods. They are modeled on the Central Act.

8.6 The Second Schedule which specifies goods in respect of which single point purchase tax only is leviable, includes certain ores of minerals under survey and mentions the rate of tax as shown below :

Description of the goods	Point of levy	Rate of tax
Manganese (including manganese ore)	At the point of purchase by the last dealer who buys in the State.	3 Naya Paise in the rupee.
Iron ore	—do—	—do—
Mica	—do—	—do—

9. Foreign Exchange Regulations As Affecting Foreigners and Foreign Companies.

9.1 The scheme of exchange control in India is as per The Foreign Exchange Regulation Act, 1947. The Act empowers the Indian Government and the

Reserve Bank of India to control and regulate all dealings and transactions involving :—

(a) foreign exchange and foreign securities in India.

(b) payments to persons resident outside India.

(c) transfer of securities to non-residents.

(d) other miscellaneous matters.

9.2 The Reserve Bank does not deal directly with the public on foreign exchange transactions. It has authorised licensed dealers for this purpose which include banks and a few travel agencies. Besides, there are licensed dealers known as authorised money exchangers who are engaged in buying and selling foreign currency notes and coins.

No person is permitted to make payments directly or indirectly to persons resident outside India except with the general or special permission of the Reserve Bank of India. The general permissions are made known either through notifications in the official Gazette or circulars to authorised dealers.

9.3 The whole scheme of exchange control is based on residence or non-residence in India of the persons involved. However, these expressions have not been defined under the Foreign Exchange Regulations Act, 1947, nor are they identical with the expressions "resident" and "non-resident" under the Income Tax Act discussed earlier. The presumption is that a person is a resident of India if he maintains his home in India, resides there for a substantial part of each year and pays income tax as an Indian resident.

9.4 The Indian Exchange Control is based on a single rate of exchange for international transactions. The Act empowers the Reserve Bank of India to fix the rate of exchange which is :

£ 1 sterling	=	Rs. 18.08
US $ 1	=	Rs. 7.50

9.5 Import and export of currency notes and coins, Indian as well as foreign, are subject to exchange control.

Export of securities including shares (whether sent or carried out) requires permission of the Reserve Bank. Such export permit is necessary even where the transfer of interest or acquisition was previously approved by the Reserve Bank.

9.6 Repatriation of foreign investment is subject to exchange control. Transfer of capital investment in India by non-residents to residents by sale or liquidation requires prior approval of the Reserve Bank of India.

At times in approving foreign collaborations, the Indian Government may require a foreign investor to agree not to repatriate the equity participation in the industrial undertaking for a specified period of years.

9.7 Even though the foreign investors have many pre-emptive rights to further issue of shares under Section 81 of the Companies Act, 1956, they require prior approval before they are exercised.

9.8 *Remittances of Profits.* Applications from branches or subsidiaries in India of foreign firms and companies to remit profits to their parent firms/companies outside India are required to be made to the Reserve Bank through the applicant's bank. The application should be supported by audited Profit and Loss Account Statements and documentary evidence of payment of Indian income tax and other taxes, or a certificate from the Company's auditors that sufficient funds have been set aside to meet such liabilities.

Applications for remittance of dividend on substantial holdings, that is, where the beneficiary of a remittance is the holder of 25% or more of the total shares issued by a Company, has to be referred to the Reserve Bank for prior approval.

9.9 *Personal Remittances.* Private monthly remittances by foreigners may be effected without prior approval of the Reserve Bank of India upto Rs. 2,360/- or 50% of the remitter's monthly income, whichever is lower. Net monthly income is defined as the taxable income of the person in India less the amount of tax payable, as well as any other deductions at source such as contributions to provident fund, pension, etc.

The Exchange Control Regulations permit foreigners to make such remittances in advance not more than twice in any calendar year against the quota for the following month. Additionally while a foreigner is on leave abroad banks, under instructions from the employer of the concerned individual, can remit the net leave salary in full to the country of residence of the foreigner as and when it accrues.

This facility for personal remittances can be availed of provided that the Reserve Bank has approved either the foreigner's engagement in India or his QA 22 Form for operation of a bank account in India. The foreigner must also be in possession of a current visa covering his stay in India.

Foreigners leaving the country on retirement can repatriate their funds subject to a maximum of Rs. 75,000/-. If any amount is still outstanding, it can be repatriated in annual instalments not exceeding Rs. 20,000/-.

9.10 *Remittances of Royalties/Technical Consultancy Fee.* Proposals for foreign collaboration involving payment of royalties or technical consultancy fees have to be referred by firms and companies directly to the Ministry of Government

of India dealing with the particular industry. If the proposed agreement is approved, the Government of India informs the applicant of their decision and a formal authorisation under the Foreign Exchange Regulations is issued by the Reserve Bank. Remittances under these arrangements are, however, subject to the prior approval of the Reserve Bank. Applications for such remittances should, therefore, be made to the Reserve Bank citing the authorisation issued by Exchange Control Department.

10. Labour Laws.

10.1 *The Payment of Wages Act, 1936.* Under this Act every employer in a factory is required to pay the wages before the expiry of the seventh day of the last day of the wage period if the number of employees in the establishment is less than 1000 persons. and if they exceed 1000 persons, then the wages should be paid before the expiry of the tenth day from the last day of the wage period. It also provides for authorised deductions from the wage. This also mentions that if an employee absents, appropriate wages can be deducted. But if ten or more employed persons working in a concern absent themselves without due notice, i.e. the notice required under the terms of their contract of employment, and without reasonable cause, then such deductions may include an amount not exceeding wages for eight days.

It also provides procedure for settlement of claims for non-payment or deductions from wages and appeals therefor. In every State there is a Shops and Establishments Act in which similar provisions have been made in respect of establishments and shops other than factories. These enactments, however, do not provide the quantum of wages to be paid to employees. If the quantum of wage payment is disputed and it gives rise to a collective dispute in the sense that subsequently a number of workmen or the Union raise the dispute, then in that case the matter can be taken up by the Conciliation Officer for conciliation under the Industrial Disputes Act and in the absence of conciliation, the Government has powers to refer the dispute for adjudication to an Industrial Tribunal or Labour Court. The parties can also refer the dispute to arbitration instead of getting it decided by adjudication.

In India it is customary to divide the wages into two parts. One is called basic wage or basic pay. In addition to this basic wage or basic pay, it is usual to give dearness allowance. Dearness allowance is being given since the Second World War in order to compensate either fully or partially for the rise in the Cost of Living Index number. The dearness allowance is sometimes linked to the rise or fall in the Cost of Living Index number and if it is not so linked, it is reviewed from time to time. The basic wage may be fixed wage or it may consist of pay scales in which increments are granted annually, if there is no defect in the performance of work of an employee. Sometimes, over and above the increment, the employer grants incentive wages or bonus.

10.2 *The Minimum Wages Act, 1948* provides for fixation of minimum wages, either times rate or piece rates in various employments which are mentioned in the schedule attached to the Minimum Wages Act. The State Government can add any employment to the schedule if it is of opinion that minimum rates of wages should be fixed under the Act, in respect of that employment. The Minimum Wages Act provides the procedure and the conditions subject to which the minimum rates are fixed by the Government. It does not lay down the minimum wages by itself. Under the Minimum Wages Act the State Governments have issued notifications providing minimum rates of wages in various employments. The minimum rates are statutarily binding on employers and no one can pay below the minimum rates. Under the Minimum Wages Act various rules have also been framed by the State Governments. These rules provide for authorised deductions from the wages and also a weekly day of rest with wages. It also provides the maximum hours of work and extra wages for overtime at double the rates in scheduled employments and 1½ the ordinary rates of wages in agricultural employments.

10.3 *Payment of Bonus Act, 1965.* The minimum bonus is 4% while the maximum is 20% of the total wage including dearness allowance in a year. These payments are required to be made annually and, according to the Payment of Bonus Act, within eight months of the close of a year. The workers can claim bonus if the profits of the employer are sufficiently large and any surplus remains after allowing for depreciation, development rebate, taxes and suitable return on the amounts invested in business, and in case of partnership some provision on account of the efforts of partners engaged in business.

10.4 *Employees' Provident Fund Act, 1952.* The Act applies both to commercial as well as industrial establishments employing more than 20 workmen. Under this Act there is a scheme called the Employees' Provident Fund Scheme in which every employee is required to become a member.

6¼% of the basic wage and dearness allowance is deducted out of the salaries of employees and a similar amount is to be contributed by the employers. In certain industries the rate of deduction and contribution is 8%. The entire amount along with interest is payable to employees at the time of leaving the service or at retirement, according to the Act.

10.5 *Industrial Disputes Act, 1947.* This Act provides that the workers can raise industrial disputes in respect of the terms and conditions of their employment and also termination or non-employment. Whenever any such dispute is raised, it is to be decided by an Industrial Tribunal or Labour Court. These authorities have power in appropriate cases to order re-instatement of employees who are found to be dismissed or discharged wrongfully or illegally. They have also power to change the terms and conditions of employment and also the emoluments to be paid to the employees.

The Act also provides for appointment of Industrial Tribunals and Labour Courts for adjudication of all industrial disputes. It also provides that before making any change in respect of service matters, the employer will give a notice of change. It also provides for registrarion of settlements with the Conciliation Officer and also for conciliation of disputes. During conciliation and adjudication an employer cannot dismiss or punish a worker without approval or permission of the Conciliation Officer, Labour Court or Industrial Tribunal, before whom the dispute might be pending. It also provides compensation in case of retrenchment and lay-off and closure of business or trade.

10.6 *The Indian Trade Unions Act, 1926.* It provides for registration of trade unions and maintenance of records. It also regulates the working of trade unions and the objects for which their funds can be spent. The trade unions and their officers or members have been provided immunity from civil suits in case they induce other persons to make contract of employment.

10.7 *The Industrial Employment (Standing Orders) Act, 1946.* This Act makes obligatory the framing of standing orders upon the employers in respect of classification of workmen, manner of intimating periods of hours of work, holidays, pay days and wage rates, shift working, attendance and late coming, procedure for taking leaves, requirement to enter the premises by certain gates, liability to search. closing and re-opening of sections of industrial establishments, temporary stoppage of work and termination of employment. Every industrial establishment having more than 100 employees will be governed by this Act. The industrial establisnments will include factories, railways, mines, etc. The standing orders are drafted by employers and they are certified by a Certifying Officer, if he finds them reasonable. Appeal is also provided against the orders of the Certifying Officer.

10.8 *The Personal Injuries (Compensation Insurance) Act, 1963.* This Act applies to workmen, inter alia, in mines and all employments declared as "Essential Service" under the Defence of India Rules. By this Act all employers are required to compensate the employees for personal injuries over and above any relief provided under the Personal Injuries (Emergency provisions) Act, 1962. The employers can, however, take out a policy of insurance under this Act.

Under this Act the Government has framed a scheme, known as the Personal Injuries (Compensation Insurance) Scheme, 1965, whereby employers are required to take out policies from the 1st of January, 1966 and the advance premium for the first quarter of 1966 is 25 paise per 100 rupees of the total wage bill.

10.9 *The Maternity Benefit Act, 1961.* This Act applies to factories, mines and plantations. By this Act a pregnant woman employee should be excused from work during six weeks immediately following the day of delivery or mis-carriage without loss of wages. She cannot bs dismissed or discharged during this period.

10.10 *The Apprentices Act, 1961.* Under this Act certain trades are specified and the employers are required to train apprentices in those trades in their establishments. It is not obligatory to emply those apprentices after they are trained. This Act is designed to overcome the shortage of trained personnel.

10.11 *The Children (Pledging of Labour) Act, 1933.* By this Act an agreement to pledge the labour of a child is prohibited.

10.12 *The Employment of Children Act, 1933.* This prohibits the employment of children in certain occupations and regulates their employment in other occupations.

ANNEXURE 'A'

RATES OF PARTNERSHIP INCOME TAX FOR ASSESSMENT YEAR 1972-73

In the case of every registered firm

(1) Where the total income does not exceed Rs. 10,000.	Nil
(2) Where the total income exceeds Rs. 10,000 but does not exceed Rs. 25,000	4 % of the amount by which the total income exceeds Rs. 10,000 ;
(3) Where the total income exceeds Rs. 25,000 but does not exceed Rs. 50,000	Rs. 600 plus 6 % of the amount by which the total income exceeds Rs. 25,000 ;
(4) Where the total income exceeds Rs. 50,000 but does not exceed Rs. 100,000	Rs. 2,100 plus 12 % of the amount by which the total income exceeds 50,000 ;
(5) Where the total income exceeds Rs. 100,000	Rs. 8,100 plus 20 % of the amount by which the total income exceeds Rs. 100,000 ;

Surcharges of Income tax

The amount of income-tax computed at the rate hereinbefore specified shall be increased by the aggregate of surcharges for purposes of the Union calculated as specified hereunder :—

(a) in the case of a registered firm whose total income includes income derived from a profession carried on by it and the income so included is not less than 51 % of such total income, a surcharge calculated at the rate of 10% of the amount of income-tax computed at the rate hereinbefore specified ;

(b) in the case of any other registered firm, a surcharge calculated at the rate of 20 % of the amount of income-tax computed at the rate hereinbefore specified ; and

(c) a special surcharge calculated at the rate of 10% on the aggregate of the following amounts, namely :—

(i) the amount of Income tax computed at the rate hereinbefore specified; and

(ii) the amount of the surcharge calculated in accordance with clause (a), or, as the case may be, clause (b) of this sub-paragraph.

Explanation. For the purposes of this paragraph, "registered firm" includes an unregistered firm assessed as a registered firm.

ANNEXURE 'B'
RATES OF INCOME TAX
FOR ASSESSMENT YFAR 1972-73

In the case of every individual or Hindu undivided family or unregistered firm or other association of persons or body of individuals, whether incorporated or not, or every artificial juridical person referred to in sub-clause (vii) or clause (31) of section 2 of the Income-tax Act, not being a case to which any other Paragraph of this Part applies :—

	Rates of Income tax
(1) Where the total income does not exceed Rs. 5,000	Nil
(2) Where the total income exceeds Rs.5,000 but does not exceed Rs. 10,000	10% of the amount by which the total income exceeds Rs. 5,000 ;
(3) Where the total income exceeds Rs. 10,000 but does not exceed Rs. 15,000	Rs. 500 plus 17% of the amount by which the total income exceeds Rs.10,000 ;
(4) Where the total income exceeds Rs. 15,000 but does not exceed Rs. 20,000	Rs. 1,350 plus 23% of the amount by which the total income exceeds Rs. 15,000 ;
(5) Where the total income exceeds Rs. 20,000 but does not exceed Rs. 25,000	Rs. 2,500 plus 30% of the amount by which the total income exceeds Rs. 20,000 ;
(6) Where the total income exceeds Rs. 25,000 but does not exceed Rs. 30,000	Rs. 4,000 plus 40% of the amount by which the total income exceeds Rs. 25,000 ;
(7) Where the total income exceeds Rs. 30,000 but does not exceed Rs. 40,000	Rs. 6,000 plus 50% of the amount by which the total income exceeds Rs. 30,000 ;
(8) Where the total income exceeds Rs. 40,000 but does not exceed Rs. 60,000	Rs. 11,000 plus 60% of the amount by which the total income exceeds Rs. 40,000 :
(9) Where the total income exceeds Rs. 60,000 but does hot exceed Rs. 80,000	Rs. 23,000 plus 70% of the amount by which the total income exceeds Rs. 60,000 ;
(10) Where the total income exceeds Rs. 80,000 but does not exceed Rs. 1,00,000	Rs. 37,000 plus 75% of the amount by which the total income exceeds Rs. 80,000 ;

(11) Where the total income exceeds Rs. 100,000 but does not exceed Rs. 200,000	Rs. 52,000 plus 80% of the amount by which the total income exceeds Rs. 100,000 ;
(12) Where the total income exceeds Rs. 200,000	Rs. 132,000 plus 85% of the amount by which the total income exceeds Rs. 200,000 ;

Provided that for the purposes of this Paragraph in the case of a Hindu undivided family which at any time during the previous year satisfies either of the following two conditions, namely :—

(a) that it has at least two members entitled to claim partition who are not less than eighteen years of age, or

(b) that it has at least two members entitled to claim partition who are not lineally descended one from the other and who are not lineally descended from any other living member of the family :—

(i) no income-tax shall be payable on a total income not exceeding Rs. 7,000 ;

(ii) where the total income exceeds Rs. 7,000 but does not exceed Rs. 7,660 the income-tax payable thereon shall not exceed 40% of the amount by which the total income exceeds Rs. 7,000.

Surcharge on Income tax.

The amount of income-tax computed in accordance with the preceding provisions of this paragraph shall be increased by a surcharge for purposes of the Union calculated at the rate of 10% of such income-tax on incomes upto Rs. 15,000 and 15% of the income-tax on incomes larger than Rs. 15,000.

ANNEXURE 'C'
RATES OF CORPORATE INCOME TAX FOR ASSESSMENT YEAR 1972-73

In the case of company, other than the Life Insurance Corporation of India established under the Life Insurance Corporation Act, 1956 :—

(1) In the case of a domestic company—

(i) Where the company is a company in which the public are substantially interested

(a) 45% of the total income in a case where the total income does not exceed Rs. 50,000

(b) 55% of the total income in a case where the total income exceeds Rs. 50,000

(ii) where the company is not a company in which the public are substantially interested

(a) in the case of an industrial company

(1) 55% on so much of the total income as does not exceed Rs. 1,000,000

(2) 60% on the balance, if any, of the total income

(b) 65% of the total income in any other case.

Provided that the income-tax payable by a domestic company, being a company in which the public are substantially interested, the total income of which exceeds Rs. 50,000 shall not exceed the aggregate of:

(1) the income-tax which would have been payable by the company if its total income had been Rs. 50,000 (the income of Rs. 50,000 for this purpose being computed as if such income included income from various sources in the same proportions as the total income of the company) ; and

(2) 80% of the amount by which its total income exceeds Rs. 50,000.

2. In the case of a company other than a domestic company—

(i) On so much of the total income as consists of—

(a) royalties received from an Indian concern in pursuance of an agreement made by it with the Indian concern after the 31st day of March, 1961, or

(b) 50% fees for rendering technical services received from an Indian concern in pursuance of an agreement made by it with the Indian concern after the 29th day of February, 1964 and where such agreement has in either case been approved by the Central Government.

(ii) 60% on the balance, if any, of the total income.

PART IV

Comparison of Legislation in India and Canada

CHAPTER I—DIRECT LEGISLATION

1. Introduction

1.1 This chapter is based on information on Canadian legislation derived from the following digests published by the Mineral Resources Branch, Department of Energy, Mines and Resources of Canada :

1. Digest of Canadian Mineral Laws, 1966.
2. Summary Review of Federation Taxation and Legislation Affecting the Canadian Mineral Industry, 1969.
3. Canada Mining Regulations, 1961.
4. Canada Income Tax Act, 1969.

The information given in the said two digests high-lights only the salient features of legislation pertaining to mining in Canada. The information is very limited and general and the booklets themselves indicate that the information regarding provisions of various legislations are "not necessarily the only provisions applicable." As regards the Income Tax Act, no Finance Act or yearly budget statements were available.

1.2 Canada and India both have a federal Constitution. The Canadian Constitution also has legislative Lists, which distribute the legislative powers between the Dominion of Canada and the Provinces of Canada.

However, neither of the Lists in the Canadian Constitution have provisions similiar to that of Entry 54 of List I and Entry 23 of List II of the 7th Schedule to the Indian Constitution. Those provisions provide that legislative power with regard to the development of mines and minerals shall vest with the Parliament to the extent it considers expedient.

In Canada, legislative powers with regard to the development of mines and minerals are distributed between the Crown and the Provinces although no mention is made of this in the legislative Lists. In Canada each of the Provinces has its own mining act, tax, labour and safety laws.

1.3 Canada has no equivalent of the Industrial Policy Resolution of India 1956 which lays down the economic policy to be pursued by the Government of India. Neither does Canada have an equivalent of the Indian public, private or co-operative sector organisations.

1.4 In Canada there is no classification of minerals into 'minor minerals' or 'specified minerals' such as there is in India.

1.5 Canada does not have the equivalent of the Indian Industries (Development and Regulation) Act, 1951. Canada also does not have a series of mining laws as specified on page 3 of Chapter I of Part III.

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1.6 The following are the major distinctive features of the Canadian mining laws which are dealt with in this Part :-

(a) In Canada unlike India, each of the Provinces has its own mining safety, labour and tax laws. Although the provincial laws are modelled primarily on the pattern of the Central Canadian Mining Laws and Regulations, each Province is completely independent and entitled to formulate its own laws and regulations with regard to mining.

(b) Under the Canadian and Provincial mining laws a national of any country in the world can apply for a prospecting or mining licence anywhere in Canada or the Provinces. The only restriction appears to be that such an applicant should be at least 18 years old.

(c) Depletion allowance is written into the Income Tax Acts of Canada and the Provinces.

(d) Bona fide prospectors and persons who employ them or provide financial backing for prospecting activities are exempt from tax to the extent of their investment in any such activity and also from the sale of all or any part of an interest in mining property acquired as a result of the prospector's efforts.

(e) There are large deductions and exemptions on account of exploration and development expenses sales tax, customs and excise duties.

2. Canada Mining Regulations, 1961

2.1 These Regulations have been enacted by the Canadian Parliament. This is the only enactment which bears directly on mining and minerals in Canada. These Regulations are cited as the Canada Mining Regulations. These apply to

(a) lands in the Northwest Territories which are vested in the Crown or of which the Government of Canada has the power to dispose, and

(b) public lands as defined in the Public Lands Grants Act that are not with any Province and for the sale, lease or other disposition of which there is other provision in the law.

These Acts and Regulations do not apply to any of the following Provinces of Canada :—

British Columbia; Alberta; Saskatchewan ; Mani toba ; Ontario ;
Qubec : New Burnswick ; Nova Scotia ; Prince Edward Island ;
Newfoundland ; Yukon Territories.

The Legislatures of these Provinces have enacted their own laws on mining of minerals, labour safety rules etc. By and large the Provincial legislation has

followed the pattern of legislation enacted by the Canadian Parliament for Crown lands.

2.2 The following officers are the authorities which administer these regulations :

1. "Minister" means the Minister of Northern Affairs and National Resources.

2. 'Chief' means the Chief of the Resources Division of Northern Adminstration Branch of the Department of Northern Affairs and National Resources.

3. "Mining Recorder" means an Officer of the Department of Northern Affairs and National Resources designated by the Chief to perform the duties of a Mining Recorder under these Regulations for a mining district established under the Territorial Lands Act or for any other area of public lands which may be so declared by the Government of Canada.

4. "Mining Inspector" means an officer of the Department of Northern Affairs and National Resources designated by the Chief to perform the duties of a Mining Inspector under these Regulations.

The Officers mentioned in (2), (3) and (4) above are appointed by the Minister under the provisions of these Regulations.

2.3 Under these Regulations, minerals have been defined as follows :

"Mineral" is defined as all deposits of gold, silver and other naturally occurring substances that can be mined, excepting soil, limestone, gravel, peat, coal, oil, helium, natural gas, or other related hydrocarbons.

There is no classification of minerals into "minor minerals" or "specified minerals" such as there is in India.

"Mineral Claim" or "Claim" means a lode claim or placer claim staked out on a plot of ground in accordance with these Regulations.

Mineral rights are issued in the form of prospector's licences, prospecting permits, and mining leases.

The Chief may, for the purposes of these Regulations, designate the following :

(a) Claim Inspectors,
(b) Mining Inspectors,
(c) Mining Recorders.

3. Prospector's Licence

3.1 Both in Canada and in India no prospecting operations can be carried out without a prospector's licence. In India an application for a prospecting

licence may only be made by an Indian national or a Company in which 51% of the shares is owned by Indian nationals. Whereas, in Canada any individual 18 years of age or over and any joint stock company authorised to do business in Canada may obtain a prospector's licence upon payment of the prescribed fee. In Canada no person shall hold more than one valid licence at any time. The licence is not specific with respect to the area, as in India, but is valid for prospecting anywhere in the territory to which the Rules apply. The prospecting permit, discussed later, has more in common with the Indian prospecting licence.

In Canada a prospector's licence to a Company may only be issued by the Chief, whereas a prospector's licence to an individual may be issued either by the Chief or by a Mining Recorder.

In India the application is made directly to the State Government who may issue the licence after it receives approval to issue the licence from the Central Government in the case of "specified minerals" viz. chrome, copper, iron, lead, zinc, manganese and sulphur.

In the case of mica, bauxite and kyanite, the State requires no prior approval of the Central Government provided it issues the licence in accordance with the rules as laid down by the Central Government.

3.2 Schedule of Fees.

	Canadian Dollars
Individual prospector's licence ...	5.00
Company prospector's licence where the value of the authorised capaitalisation is $ 3,000,000 or less ...	25.00
where the value of the authorised capitalisation exceeds $ 3,000,000 ...	50.00
Substitutional prospector's licence ...	1.00
Prospecting permit	25.00
Lease fee	10.00
Rental under lease for original lease period per acre per year	0.25
Rental for renewal lease period per acre per year	0.50

3.3 All licences expire on March 31 following the date of issue. Only one licence may be held at a time. Such licence is not transferable. In India, a licence

for mica is granted only for one year and in the case of all other minerals under survey for a period of two years.

3.4 A licence held by a company does not entitle share-holders or employees to stake claims. But an individual who holds a licence may locate claim on behalf of a company.

3.5 The holder of a prospector's licence has the right to enter, stake prospect and develop mineral lands. Recorded mineral claims, and land occupied by buildings or otherwise reserved, are excluded.

3.6 The holder of a prospector's licence make stake in one year upto 36 mineral claims within the area shown on a mineral claim staking sheet. A mineral claim staking sheet is based on the national topographical system and is the map of an area having a width north to south of 15 minutes of latitude and a length east to west of either 30 minutes or one degree of longitude depending on whether the area lies south or north of 68 degrees north latitude.

3.7 The area of a claim may not exceed *51.65 acres*. The sides of the claim may not exceed 1,500 feet and should be as nearly as possible astronomic north-south and east-west. Under the Indian Law, no person shall be given in one State one or more prospecting licences covering a total area of more than 50 square miles.

3,8 Claims must be recorded within 60 days if they lie in the Arctic and Hudson Bay Mining District or north of 65 degrees north latitude in other mining districts. Otherwise they must be recorded within 40 days.

3.9 The holder of a recorded mining claim may retain it for not more than 10 years by performing representation work to the value of $ 100 each year. Representation work may consist of trenching, shaft sinking, underground work, drilling and geological, geophysical and geochemical investigations and engineering evaluations. Not more than 19 contiguous claims may be grouped for purposes of representation work.

3.10 Geological, geochemical and geophysical data are kept confidential for a period of three years after the recording of such representation work reports.

4. Prospecting Permits

4.1 The "Prospecting Permit", in Canadian law, is more akin to the Indian prospecting licence, as it specifies the area and gives the holder exclusive right to prospect it.

4.2 Applications for a prospecting permit shall be made to the Chief. The permit grants the holder exclusive right for a period of 3 years to prospect for

and develop minerals within the permit area. The period of 3 years commences on the first day of April following the date of issue of the permit. A prospecting permit must contain the area shown on a mineral claim staking sheet.

An application for a permit may be made between January 1 and March 15 in any year. Permits are issued only between March 16 and April 1 in any year. The application must be accompanied by a fee and a performance bond.

4.3 The applicant for a prospecting permit shall undertake to spend the following amounts on work in the area of the prospecting permit :

(a) during the first year an amount to be determined by multiplying the number of acres in the permit area by 10 cents ;

(b) during the second year an amount to be determined by multiplying the number of acres in the permit area by 20 cents; and

(c) during the third year an amount to be determined by multiplying the number of acres in the permit area by 40 cents.

Any work performed during any year in the permit area in an amount in excess of the amount required to be performed for that year as above mentioned in (a), (b), (c) may be carried forward as performed for the next following year or years for the purpose of fulfilling the requirements for that following year or years.

If the Chief is satisfied that a permit holder has in any year spent on a permit area an amount in excess of the amount he has undertaken to spend on work in the area, the excess of the amount so spent by him shall be deemed to be work performed on mineral claims, held by him within that permit area, for the next year.

4.4 The granting of a permit in respect of any permit area is subject to the rights of any recorded owner in the area.

4.5 The holder of a valid permit may stake 90 claims in the permit area in the first year, in the second year the difference between 270 claims and the number of claims staked in the first year and in the third year the difference between 450 claims and the aggregate number of claims staked in the first and second years.

4.6 A permit holder must release an area of not less than one quarter of the permit area at the end of the first year, and may not retain more than half the permit area after the end of the second year. The area retained need not be in a contiguous parcel.

4.7 Once the rights under a permit have expired, the holder may not stake and record claims within the area for a period of one year.

4.8 The Governor-in-Council may, where he considers such to be in the public interest, withdraw areas for disposal under these Regulations and grant to such person as he deems fit the exclusive right to explore for and develop minerals in areas so withdrawn upon such terms and conditions as the Governor-in-Council may impose.

4.9 Reports submitted by the holder of an area are kept confidential until 3 years after the expiry of the permit.

5. Application for Lease of Mineral Claims

5.1 An application for a lease for a mineral claim may be made only after the claim has been recorded or under some of the conditions mentioned in this Part.

The Indian Law has no provision which makes it obligatory for a holder of a mineral claim to apply for a lease if the production from the mineral claim exceeds a particular limit.

5.2 A lease of a mineral claim may be obtained upon application to the Chief if sufficient representation work has been done to maintain the claim in good standing for 5 years, and if such work included at least 3 years of physical work such as trenching, shaft sinking, underground work or drilling. A survey of the claim is required.

The holder of a mineral claim must apply for a lease if at any time the production of ore from a mineral claim exceeds 5 tons per day, except for testing purposes, and where a lease has not been applied for before that date.

The interest of a recorded owner of a mineral claim, prior to the issue of a lease, shall be deemed to be a chattel interest equivalent to a lease of the minerals under the land for one year and thereupon from year to year terminable in accordance with these Regulations.

Within thirty days after the expiration of each year during which work on a mineral claim is required to have been performed under these regulations the recorded owner or his agent shall furnish the Mining Recorder, with whom the claim has been recorded, with a sworn application for a certificate of work in a prescribed form stating that the required amount of work has been performed.

5.3 A lease of a mineral claim shall be applied for before the expiration of thirty days after expiration of the tenth year from the date of recording of the claim and, where a lease has not been applied for before that date :

(a) the claim shall be deemed to have lapsed without any declaration of cancellation or forfeiture on the part of Her Majesty and to have been forfeited to Her Majesty at the end of the said tenth year; and

(b) the land that was claimed shall be open for reallocation under these Regulations after noon of the day next following the expiration of thirty days from the date the claim lapsed.

5.4 The recorded owner of a mineral claim may apply to the Mining Recorder with whom the claim is recorded for a lease of the claim.

Upon receipt of an application for a lease, the Mining Recorder shall forward the application to the Chief, who may

(a) recommend to the Minister that the lease be granted; or

(b) reject the application if the applicant has not complied with all the provisions of these Regulations.

Where the Chief rejects an application under sub-section (b), he shall notify the applicant by registered mail stating the ground for his rejection of the application and the applicant shall have thirty days from the date of the notice of rejection in which to submit evidence satisfactory to the Chief that he has complied with all the provisions of these Regulations.

Upon the recommendations of the Chief, the Minister may grant a lease to the applicant.

5.5 Any lease for a mineral claim issued pursuant to these Regulations is valid for a period of twenty one years from the date of its commencement and confers on the lessee the right to renew the lease for an additional period of twenty one years and thereafter to obtain renewals of the lease subject to such terms and conditions as may be prescribed by the Governor-in-Council. Renewals of lease of mineral claims on which production has been attained shall be automatic at the end of each twenty one year period as long as the claim remains productive.

In India the period for which a mining lease is granted, shall not, in the case of iron and bauxite, exceed 30 years and in all other cases it shall not exceed 20 years. Renewal for such mining leases in the case of iron and bauxite shall be for one period not exceeding 30 years and in the case of any other mineral for one period not exceeding 20 years.

5.6 The recorded owner by entry or by lease of a mineral claim held under these Regulations, shall be entitled to all minerals found separately or in combination in, under or within the lands indicated in the entry or lease. The entry or lease does not convey any other right, title or claim to the surface rights of the claim or lease other than the right to enter upon or occupy such part or parts of the surface thereof as are necessary for the purpose of prospecting, exploring and developing mines and operating mines therein.

A lease of a mineral claim located on lands in respect of which the surface rights have been disposed of, and the right to enter, prospect and mine for minerals reserved to the Crown, shall convey to the lessee all minerals whether found separately or in combination which may be in, upon, or under the land described in the lease but shall convey no right of entry upon the surface of the land.

5.7 The Chief, upon proof to his satisfaction of the wilful contravention of any of the provisions of these Regulations by a person holding a prospector's licence, may revoke the prospector's licence issued to that person during such period as the Chief may, in his discretion, prescribe.

5.8 Leases are granted only to persons over 18 years of age or to companies incorporated in Canada. A lease will not be issued to a corporation unless :

(1) at least 50 per cent of the issued shares of the corporation are beneficially owned by persons who are Canadian citizens, or

(2) the shares of the corporation are listed on a recognised Canadian Stock Exchange and Canadians have an opportunity of participating in the financing and ownership of the corporation, or

(3) the shares of the corporation are wholly owned by a corporation that meets the qualifications outlined in (1) or (2).

Iron ore produced from islands in Hudson Bay may be exported. All other ores and minerals must be treated or refined within Canada to the stage of refined metal or other product usable without further treatment.

5.9 Right of entry. A prospector may enter land on which the surface rights are held by another person only with the written permission of the owner and the Mining Recorder.

6. Disputes

6.1 All disputes arising out of any of the provisions of these regulations shall be settled in the first instance in accordance with the chapter on disputes as contained in these regulations, in the following manner.

6.2 In the case of a dispute as to the location of a mineral claim, the title of the claim shall be recognised according to the priority of location. This is similar to the provisions under Indian laws.

Any irregularity that occurred previous to the date of the recording of the last certificate of work in respect of the mineral claim shall not affect the title therein and except where fraud is proved, the title to a mineral claim shall be deemed to be a good and valid title upto the date of the record of the last certificate of work affecting the title.

6.3 The Chief shall have the power to make any necessary inquiries, direction and references for the purpose of vesting the title in a bona fide acquirer of the claim.

A Mining Recorder shall have the power to hear and determine all disputes arising with respect to a mineral claim, within his district, before issue of a lease.

6.4 The matter complained of in a dispute shall be properly set out in writing and

(a) one copy of the complaint filed with the Mining Recorder; and

(b) one copy of the complaint served on the opposite party;

not less than seven days before the hearing of the complaint or within such other time as the Mining Recorder deems necessary. The Mining Recorder may require any party to a dispute to file affidavits verifying the facts or make any amendments. A Mining Recorder may summon any person before him by a subpoena issued by him, examine the person under oath and compel the production before him of all papers and documents.

6.5 An appeal shall lie from the decision of the Mining Recorder or Chief to a Judge of a Territorial Court.

6.6 In India, applications regarding disputes under the Indian Minerals Laws are made directly to the State Government or the Central Government, which has revisionary powers. The procedure followed is the same as under the Canadian regulations as regards filing of complaints, summoning of witnessess and recording evidence.

After a decision by the Government concerned an appeal can be made to the High Court of the State or the Supreme Court directly if a case for violation of a property right can be made out.

7. Mineral Royalty, Dead Rent, Surface Rent

7.1 Royalty. Annual royalty is payable on the value of the output of a mine at the following rates :

(a) on the first \$ 10,000	...	Nil
(b) \$ 10,000 to 1,000,000	...	3 per cent
(c) \$ 1,000,000 to 5,000,000	...	5 per cent
(d) \$ 5,000,000 to 10,000,000	...	6 per cent

(e) above \$ 10,000,000—a proportional increase of 1 per cent for each additional \$ 5,000,000 with a maximum rate of 12 per cent.

A mine is exempt from royalty for the first 3 years after the production date. Two or more mines owned or operated by the same company are treated as separate mines.

The Canadian Mining Regulations do not have any provision regarding royalty free movement of any quantity of ores and minerals, such as there is in India (Annexure C in Chapter I of Part III). Furthermore, the royalty rates in Canada as mentioned above are based on a percentage of the output of a mine in terms of tonnage. The Canadian schedule of royalty payable on the output of a mine appears to be the same for all minerals whereas, in India each mineral has a different rate of royalty (Annexure A of Chapter I of Part III).

7.2 Surface Rent. The annual surface rent is 25 cents per acre during the first 21 year lease period and 50 cents per acre during periods of renewals. This amount of surface rent is reduced by the amount of royalty paid on production and by the amount of expenditure on development work approved by the Department. The Canadian "surface rent" would seem to be the counterpart of the Indian "dead rent".

CHAPTER II—INDIRECT LEGISLATION

1. Partnership

No materials with regard to the Canadian Partnership Act have been available. Neither has any material been available regarding Partnership Taxation.

2. Corporations

In Canada there are only two types of Companies, namely, public and private Companies. Their corporate structure is akin to Indian private and public Companies. There is no equivalent in Canada to the Government Undertakings and Government-owned Companies or Companies as defined under the Indian Income Tax Act. In Canada if the Government were to float a Company, it would be exactly on the same footing as any other private or public Company. The Canadian Corporation Act has not been available for study.

3. Taxation

3.1 The Canadian Income Tax Act as enacted by the Canadian Parliament has a separate Chapter regarding taxation of mines and corporations whose principal business is mining.

3.2 The value of the output of a mine for a fiscal year is defined as the actual

market value or the appraised value of the output minus the following allowable deductions under the Income Tax Act :

(a) transportation charges to the smelter, treatment plant, or refinery incurred in the year ;

(b) smelter treatment and refining charges, incurred in the year, not elsewhere deducted from the output value ;

(c) smelter, mill and refining costs at the mine incurred in the year ;

(d) mine and mill operating, repair and maintenance costs incurred in the year;

(e) exploration and development costs at the mine incurred in the year ;

(f) general and indirect expenses incurred in the year, not elsewhere allocated to operating expenses where such expenses are incurred for property, employees or operations at the mine ;

(g) a depreciation allowance, at an annual rate determined by the Minister upon consideration of the cost to the operator of the depreciable assets of the mine at the time when royalties on the mine first become payable and exceeding 15 per cent per year and 100 per cent in the aggregate of the cost to the operator of the depreciable assests used in the production of the output of the mine ;

(h) in the case of a mine that starts production after the 3rd day of March, 1961, a preproduction allowance at an annual rate determined by the Minister upon consideration of the costs to the operator of all expenses incurred for prospecting and for exploration and development of the mine at the time when royalties on the mine first become payable and not exceeding 15 per cent per year and 100 per cent in the aggregate of all such expenses incurred by the operator of the mine prior to the day on which production was started ;

(i) if the costs incurred by the operator of the mine during the year in conducting exploratory work on land to which these regulations apply are not claimed by him or the operator of any other mine under any other provisions of these Regulations, the lesser of

  (i) the said costs; or
  (ii) ten per cent of the total value of the output of the mine for the year before making any deductions; and

(j) if the ore, mineral or mineral bearing substance or any part thereof is not sold in the year but is treated by the operator of the mine within the Northwest Territories, an annual processing allowance amounting to the lesser of

  (i) 8 per cent of the original cost to the operator of the mine of the assests

in the Northwest Territories used in such processing including machinery, equipment and plant, or

(ii) 65 per cent of the value of the output of the mine as determined under this section but before deducting this allowance.

3.3 No deductions may be made for any of the following :

(a) the capital cost of the plant, machinery, equipment or building except as provided in paragraph (g) above ;

(b) depletion in the value of the mine, mining land or mining property, by reason of exhaustion or partial exhaustion of the ore or mineral ;

(c) President's and other elected officials' salaries ;

(d) Director's fees ;

(e) Director's travelling expenses ;

(f) stock transfer agents' fees ;

(h) shareholders' reports and meetings ;

(h) interest on overdrafts and loans, debentures and bonds ;

(i) head office or executive office expenses ;

(j) taxes and royalties paid on the basis of profit or income but not including municipal taxes ;

(k) royalties paid for use of mining property ;

(l) legal, accounting and other expenses in connection with incorporations, re-organisations, security issues or stock issues ;

(m) management and consultant services and expenses except when incurred at the mine ;

(n) bond discounts or discounts on shares sold or issued ;

(o) increase in reserves or provision for contingencies ;

(p) dues and memberships other than for mine employees ;

(q) insurance other than that applicable to the mine product, property or employees at the mine ;

(r) cost incurred properly attributable to revenue other than the gross receipts from the year's output of the mine described in this section ; and

(s) any expenses not properly vouched.

4. Depletion

4.1 An allowance commonly referred to as "depletion" is permitted as a deduction in computing the income of the operator of a mine under the Income Tax Act. This deduction is primarily intended to compensate for the exhaustion of the natural resources. In India the Income Tax Act makes a provision for such an allowance only by negotiation and not by mandatory right as embodied in the Canadian Income Tax Act. Neither does the Indian Act specify the amount of such an allowance.

4.2 The amount deductible by the operator of one or more of the following :

(a) a metalliferous mine (except a gold mine),

(b) an industrial mineral mine where the mineral is contained in a non-bedded deposit,

is 33 1/3 % of the aggregate of the profits and losses reasonably attributable to the production from all such mines, wells and deposits after certain deductions, including prospecting, exploration, drilling and development expenses.

5. Corporate Taxation

Companies in Canada are taxed under the Canadian Income Tax Act. This Act has a special chapter on Corporate Taxation regarding the mining and mineral industry. The Indian companies are also taxed under the Indian Income Tax Act but the Indian Act has no special chapter on taxation regarding the mining and mineral industry. Listed below are some of the important provisions of Canadian Law which have no parallel in Indian Law :

5.1 36-Month Exemption for Mines. A corporation, in computing its income, is not required to include the income derived from the operation of a mine for the period of 36 months commencing with the day on which the mine came into production in reasonable commercial quantities.

5.2 Exemption from Tax of Prospector's and Grubstaker's gains. India has no provision in any of its laws which is equivalent to this provision.

Bona fide prospectors and the persons who employ them or provide the financial backing for their prospecting activities are exempt from tax on amounts received from the sale of all or any part of an interest in a mining property acquired as a result of the prospecting efforts, other than rents, royalties or similar payments received. If the consideration for the interest is shares of the capital stock of a corporation, rather than cash, any revenue derived from the subsequent sale of these shares is also exempt unless the owner disposes of them during or after carrying on a campaign to sell shares of the corporation

to the public. Amounts received from the sale of shares acquired by the exercise of an option which was accepted as consideration for the property are not exempt from tax.

5.3 Corporations qualifying as to Principal Business. Prospecting, exploration, drilling and development expenses incurred in the search for petroleum and minerals in Canada, including general geological and geophysical expenses, may be deducted in computing the income of certain corporations. The corporations entitled to this benefit are those whose principal business is

(1) mining or exploring for minerals, or

(2) processing mineral ores for the purpose of recovering metals therefrom, or a combination of this processing with the processing of metals so recovered.

These expenses incurred in a year are deductible in that year to the extent of the corporation's income from all sources. If the aggregate of such expenses exceeds the income, the excess may be deferred and is deductible from the income of subsequent years.

Such a corporation may deduct exploration and development expenses incurred pursuant to an agreement under which it undertook to incur the expenses in consideration for shares of the capital stock of a corporation that owned or controlled the mineral rights or in consideration for an option or right to purchase such shares or the shares of corporation to be formed for the purpose of acquiring or controlling the mineral rights. Under these circumstances, however, neither the owner of the mineral rights nor any other party is permitted a deduction in respect of these expenses.

Where a new qualifying corporation has been formed as a result of the amalgamation of two or more corporations, the new corporation, under certain circumstances, may deduct exploration and development expenses previously incurred by its predecessor corporations. The allowance is limited to the balance of expenses eligible for deduction which were not deductible by each predecessor corporation in computing its income and may not, in any year, exceed the income from production for the year from the property owned by each particular predecessor immediately before amalgamation.

A joint exploration corporation may elect to renounce in favour of another corporation, whose principal business qualifies as previously described, an agreed portion of the exploration, drilling and development expenses incurred in the search for petroleum, natural gas or minerals in Canada by the joint exploration corporation, during a period, after the calendar year 1956, throughout which the other corporation was a shareholder corporation. A "joint exploration corporation" means a corporation whose principal business qualifies as previously described and that has not at any time since its incorporation had more than 10 shareholders, not including individuals holding director—qualifying shares.

A 'sharheolder corporation" means a corporation that, for the period in respect of which the expression is being applied, was a shareholder of the joint exploration corporation, or was a corporation whose principal business qulified as previously described and made payments to the joint exploration corporation in respect of exploration during and development expenses incurred by the joint exploration corporation. The agreed portion cannot exceed in payment made to the joint exploration corporation during the period it was a shareholders corporation.

Except as noted hereunder, exploration and development expenses do not include payments for a property or a right, licence or privilege to explore for, or mine minerals, acquired before April 11, 1962.

5.4 Associations, Partnerships and Syndicates. The comments in the last five paragraphs under the heading "Corporations Qualifiyng as to Principal Business" are equally applicable to the taxation of associations, partnerships and syndicates.

5.5 Shareholders' allowance. Shareholders, resident in Canada who receive a dividend from a Corporation resident in Canada (other than a "foreign business corporation") may deduct an allowance in respect of the dividend, in computing their income, if 25 % or more of the corporation's income is derived from mineral profits. The rate of allowance varies from 10 % to 20 % and is dependent upon the ratio of the mineral profits to the total income of the corporation paying the dividend.

5.6 Tax Deduction at the Source. Every Canadian employer paying salaries, wages, commission or other similar payments is required to withhold certain prescribed percentages at the time such payments are made. Amounts so withheld are payable to the Receiver General of Canada and should be remitted to the local District Taxation Office. Indian Law has a similar provision.

5.7 Tax on Dividends paid to Non-Residents. A tax of 15% is imposed and collected at the source on dividends paid to non-residents. The tax will be reduced to 10% if the payer corporation has a degree of Canadian ownership. Tax paid at the former rate, however, is subject to a refund of one-third thereof, if the corporation acquires the necessary degree of Canadian ownership not later than in its first taxation year commencing on or after January 1, 1967. Dividend tax in India is levied at a uniform rate of 23% for all recipients of dividends both inside and outside India.

5.8 Tax on Royalties. A tax of 15 % is imposed and collected at the source of all royalties or similar payments paid to non-resident individuals or corporations in respect of the use of property in Canada, with no allowance for depletion or other deductions. Royalty is taxed at 50 %in India.

5.9 Tax on interest. A tax of 15% is imposed and collected at the source on interest paid to non-residents except interest on certain obligations which were

issued or entered into before December 20, 1960 and on certain other obligations. Indian Law has no such provision.

5.10 Additional Tax. An additional tax of 15% is imposed on non-resident mining operations carrying on business in Canada after January 1, 1961. A corporation whose principal business is mining iron ore is exempted from 1962 and subsequent taxation years. The tax is levied on the taxable income earned in Canada for the year less the aggregate of the ordinary Federal income taxes payable thereon, provincial income taxes payable that were not deductible in computing the income for the ordinary Federal income tax and an allowance in respect of net increases in the capital investment in property in Canada.

Under certain circumstances such a corporation may deduct exploration and development expenses previously incurred by another such corporation (the "predecessor corporation") if the claimant ("the successor corporation") has acquired, subsequent to 1954, all or substantially all of the property of the "predecessor corporation" used by it in carrying on, in Canada, its principal business. The allowance is limited to the balance of expenses eligible for deduction which were not deductible by the "predecessor corporation" in computing its income and may not, in any year, exceed the income from production for that year from the particular property so acquired. A deduction is also available in the same manner in a second successor corporation where the property was acquired by such a corporation after April 10, 1962. Indian Laws do not have any such provision.

6. The Excise Tax Act

6.1 The sales and excise taxes are imposed by the Excise Tax Act. Below is an outline of some of the provisions of the Act which will be of interest to the mining industry in India and for which there is no equivalent in Indian Laws.

The consumption or sales tax applies with certain exceptions to all goods produced or manufactured in Canada, or imported into Canada. Generally speaking, the rate of tax is 12% (a consumption or sales tax of 9% and an Old Age Security Tax of 3%), computed on the basis of the manufacturer's or producer's sales price. In the case of imported goods, it is computed on the basis of the duty paid value. In India, sales tax is levied under the Sales Tax Act and no such Old Age Security Tax is added to the sales tax as mentioned above with regard to the position in Canada. In India excise taxes vary from item to item and are levied on an ad valorem basis. In Canada it appears that virtually all items of mining machinery used for the exploitation of the minerals and also the import of mineral ores of all kinds are exempted from sales tax.

6.2 The following are some of the important items which are exempt from excise tax in Canada :—

(a) machinery and apparatus, including drilling bits and seismic shot-hole casing, for use in exploration for or discovery or development of minerals ;

(b) geophysical surveying precision instruments and equipment for use exclusively in prospecting for, or in the exploration and development of minerals, or for geophysical studies for engineering projects.

7. The Customs Tariff

7.1 All persons and corporations, including mining companies, are required to pay customs duties as imposed on goods imported into Canada under the items of a lengthy tariff schedule. The duties are in general according to

(1) British Preferential Tariff, applying to goods the produce or manufacture of specified British countries entering Canada without transhipment from a country enjoying the benefit of the British Preferential Tariff ;

(2) Most Favoured Nations Tariff, applying to direct imports of goods the produce or manufacture of any British or Foreign country to which the benefits of the Most Favoured Nation Tariff are extended, (the United States, which normally is Canada's largest source of imported goods, is in this class) ; and

(3) General Tariff, applying to all goods not entitled to admission under the Most Favoured Nation Tariff or British Preferential Tariff.

There are also special rates under trade agreements with certain countries.

7.2 Almost all articles of mining machinery and equipment enter Canada free from customs duty under each of the tariffs. Admittance free from duty under all tariffs includes for the followings :

(a) drills of all kinds, of a class or kind not made in Canada, and parts thereof, for use in the exploration or drilling of minerals, or in mining operations ;

(b) mine roof and wall support systems of metal ;

(c) mining machines for extracting and loading minerals directly from the working face of a mine, and parts ;

(d) trucks, tractors or shuttle cars, self-propelled, for use exclusively in underground mining operations, and parts ;

(e) conveyors of a class or kind not made in Canada, and parts thereof, for use in mines, and the development of mineral deposits, or the processing of ores, metals or minerals ;

(f) machinery or apparatus for incorporation into dredging plants, pumps, vacuum pumps, fans, blowers or compressors and scales for use with conveyors, of a class or kind not made in Canada, and parts thereof all for use in mining, the development of mineral deposits, or the processing of ores, metals or minerals ;

(g) mercury pumps and parts thereof for use in the processing, smelting or refining of ores, metals or minerals ;

(h) machinery and apparatus of a class or kind not made in Canada, and parts thereof, for use in such processes as roasting, smelting or refining of ores or minerals.

In addition to the above mining machinery and equipment allowed duty free into Canada ; other articles and materials used in connection with mining are also admitted free of duty under each Tariff.

7.3 These vast exemptions for mining apparatus and many other items used in mining operations in Canada have no parallel in India.

8. Miscellaneous

8.1 Public Lands Grants Act. The Act applies to all lands belonging to the Crown in the right of Canada including military reservations but excluding Indian Reserves. The Act authorises the making of regulations to govern the sale of public lands, including mines and minerals.

8.2 Territorial Lands Act. The Act authorises the making of regulations to govern disposition of public lands, including mines and minerals in the Yukon and Northwest Territories.

8.3 Rules and Regulations Concerning Government Prospecting and Exploration. The Federal Government does not engage directly in prospecting and exploration for mineral deposits.

The Department of Energy, Mines and Resources does, however, assist the mining industry by carrying out geological, hydrographic, oceanographic, geophysical, hydrologic, geodetic and topographical surveys, and by engaging in mineral and metallurgical research, both technological and economic.

The Department of Indian Affairs and Northern Development provides financial assistance towards the cost of mineral exploration activity in the Yukon and Northwest Territories under the Northern Mineral Exploration Programme.

8.4 Foreign Exchange Regulations regarding Repatriation of Profits. There are no regulations controlling the repatriation of profits.

8.5 Credit Facilities relating to Miners and Mine Owners.

8.5.1 Industrial Development Bank Act. There are no credit facilities sponsored by the Federal Government for the purpose of assisting mine owners. The Industrial Development Bank makes credit available under specified conditions to industrial enterprises in general and these may include mining projects.

8.6 Labour and Safety Acts.

(a) Industrial Relations and Disputes Investigation Act.

(b) Canada Fair Employment Practices Act.

(c) Female Employees Equal Pay Act.

(d) Canada Labour (Safety) Code and explanatory booklet.

(e) Canada Labour (Standards) Code, Canada Labour Code Regulations (General), and explanatory booklet.

The foregoing acts and regulations are administered by the Department of Labour.

PART V

Analysis by Activity and Inputs

CHAPTER I—LEGISLATION AND ADMINISTRATION

1. Opinions and Comments of Government and Industry

1.1 In the course of the survey the Government Departments and agencies, mining operators and industry associations interviewed were asked for their opinions on the legislative and administrative framework. The salient views expressed by them are presented in this section.

1.2 The Constitution. It was generally felt, by all concerned, that the division of legislative powers with respect to mining, as laid down in the Lists of the Constitution, was unexceptionable.

1.3 The Industrial Policy Resolution (1956). Industry spokesmen felt that inclusion of the mining of a large number of minerals among the industries which are to be primarily in the public sector had resulted in hampering of activity in these minerals. Even though mining concessions in these minerals continue to be given, there is considerable delay, often running to years, in securiug decisions on applications. Moreover, large areas bearing these minerals have been reserved for exploitation by public sector bodies, but the resources and effort assigned to the exploitation of these areas have been inadequate. As a result, activity in these minerals has not contributed to the country's economy to the extent of their potentiality.

Some State Governments think that a few more minerals could be added to the 'A' class industries. Bauxite is one of the minerals mentioned.

1.4 The Mines and Minerals (Regulation and Development) Act (1957). The First Schedule of the Act declares as "Specified Minerals" those minerals exploitation of which has been declared primarily to be in the public sector by the Industrial Policy Resolution. The State Governments have to secure the approval of the Central Government before granting or renewing any concessions in these minerals. Several State Governments think that there is no need for every case to be referred to the Centre for approval. The Centre would be kept informed of the grant of concessions as they are made, and at any time could require that further grants should be kept pending a review (by the Centre) of the situation. Granting of concessions could thus be expedited.

State Government officials said that the upper limits specified for areas granted for exploitation under concessions have no practical effect. They are easily circumvented by acquiring leases under names of relatives or firms effectively controlled by one party. On the other hand, a case is made out for fixing lower limits on the sizes. Fragmented holdings lead to wastage and inefficient mining. Also, the lower limit could be placed high enough, so that a party undertaking to exploit it will be likely to employ scientific methods of exploration and raising of the mineral.

This FRAME WAS INTENTIONALY Left Blank

Central and State officials expressed the opinion that giving the concessions to the first applicant (subject, in the case of a mining lease, to the preferential right of a person who is prospecting the same area) often results in inefficient workings by ignorant lessees. The applicant's experience in mining and the prospects for his using systematic methods (such as evidenced by his resources) should be considered. There were, however, no objective and equitable formulas offered.

1.5 The Mineral Concession Rules (1960) Certain time-limits are specified for the disposal of applications for the grant and renewal of a prospecting licence and for the grant and renewal of mining lease. The Rules declare that if an application is not disposed of within the relevant specified period, it shall be deemed to have been refused. Industry spokesmen suggest that, at least in the case of renewals if not for initial grants, the application should be deemed to have been granted if not disposed of within the relevant specified period, provided that the application is in order and eligible, within the provision of the law, for such a grant.

The requirement of a large amount of detail about the area sought to be exploited in an application for a mining lease is reported to result in inequities in the granting of licences. While one prospective applicant is gathering the requisite data, another with prospect of being able to 'influence' consideration of an application with less detail often forestalls the former. It was suggested that the application should be required to be accompanied only by adequate data to identify the area, with the priviso that further details should be submitted within a specified period after the date of application.

The MCR provides that, for violations by a mining lessee of his obligation to pay royalties and other monies due to the State, the State could issue a notice requiring him to remedy the default within a period of sixty days. For refusal on the part of the lessee to allow rights of entry and inspection to persons duly authorised to do so, the State could issue a notice requiring the lessee to show cause within a specified period, why his lease should not be terminated. In either case, if the lessee fails to satisfy the State's requirement within the relevant period, the State can terminate his lease. This is considered by mine owners to be too heavy a penalty as the breach could happen quite inadvertantly, and the time permitted for remedying it is too short, given the conditions under which they work. (The effect of this provision on the prospects of a mine owner to get financing, and likely action by the Centre to remove this handicap are discussed in the Chapter on "Credit and Capital Financing" later in this Part.

1.6 The Mineral Conservation and Development Rules (1958). The Rules specify a variety of notices and periodic returns to be submitted by a concessionaire to the Controller, Indian Bureau of Mines. Other legislations, such as the Mines Act (1952), and Central and State Government regulations require submission of

various kinds of notices and returns to other agenices. The mine operators would like to have a thorough study made of these requirements with a view to reducing the number of different forms and simplifying the presentations. Several agencies could be supplied with copies of one return, from which each agency could take the information it needs.

The Rules impose certain requirements with respect to the employment of qualified mining engineers in operating mining lesaes. Many operators, especially of open cast mines employing little mechanical equipment, feel that experienced personnel, without the necessary academic qualifications, often are better at the job than qualified, but less experienced engineers. In addition, there is not sufficient technical challenge in these mines to attract and keep good mining engineers.

1.7 Mines Act (1952), Indian Mines Rules (1955). These enactments call for provision of various amenities such as drinking water, lavatories, creches, etc. by mine owners for the benefit of the workmen. Mine owners, especially of small mines, complain that the requirements are so onerous as to seriously affect the economy of the operations if followed to the letter. At mines in less developed area, such as tribal areas, the local work force is not inclined to use the facilities even if provided and the mine owners naturally are averse to wasting money for the sake of obeying the regulations.

1.8 Metalliferous Mines Regulations (1961). This enactment specifies the qualifications for a number of semi-skilled and skilled categories of mining personnel, and also specifies minimum requirements of the different categories to be employed on various activities. Mine owners in several States have stated that personnel with sufficient formal qualifications, such as recognised certificates of proficiency, are not available. The shortage in qualified personnel in certain categories, such as mine-mates, is attributed to the low classification of these categories for the purpose of determination of minimum wages ; personnel are not attracted to qualify for these categories. One remedy would be to give adequate recognition to experience, as substitute to formal training, in these categories. This would serve as an incentive to lower categories of personnel to offer themselves for training by the mine operator in duties of the higher categories.

The Regulations also require certain 'safety' equipment, such as boots and helmets, to be provided to the workers. It is contended by mine operators that the wearing of boots in certain open cast operations, such as for bauxite, make the workers more susceptible to accidents, such as slipping. The workers prefer not to wear the boots. Helmets cannot be worn by workers (mostly women) engaged in carrying head-loads of material. Therefore these regulations call for wasteful expenditure.

1.9 Departures from legal provisions in practice. In the course of administering the legal provisions, Government agencies, especially State Governments, are

reported to have adopted practices not authorised by the laws and the regulations. One such is the requirement, sought to be imposed by at least one State, that a mining lease applied for be for an area greater than a specified minimum. In an earlier paragraph it has been stated that many State Governments expressed an opinion in favour of a minimum size for lesses.

States have also tried to impose conditions such as that the applicant for a mining lease in certain minerals undertake to set up a beneficiation or a processing plant within the State. Instances have been cited of a State seeking to limit the number of leases given to a party even though the total area under the leases will not exceed the statutory limit. States have sought to impose restrictions on the export of minerals outside the State.

1.10 Difficulties due to situations not adequately covered legally. In the matter of granting concessions, revision applications may be made to the Central Government by a party aggrieved by the State's decision. In cases in which the Centre has decided in favour of the applicant, States have been known to delay the execution of the lease deed until time could take its toll.

There are difficulties when surface rights for the whole or part of the leased area is in the possession of another party and the lessee is unable to come to satisfactory terms with the occupant for working his lease. Apparently, there are problems in the effective application of land acquisition laws to secure the necessary accommodation for the mining lesaee.

2. Proposals for Modification—Advanced by Government and Industry Committees etc.

2.1 Views on the legislative and administrative framework and suggestions for improving them are presented at the meetings of the Mineral Advisory Board. These are analysed further by the Standing Committee of the MAB or special committees appointed to go more deeply into various matters. Many recommendations for changes to legislation and improvement in administrative practices have come from these meetings ; some have been accepted by the Government. The more important of the recommendations are given in the following paragraphs.

2.2 A State Government should have the right to turn down an application for grant of a concession on the ground that the area is reserved for State exploitation *only if* its decision to so reserve the area had been announced prior to the receipt of the application. Further, an application for renewal of a licence should not be turned down merely because the Government had decided to reserve the area for State exploitation.

2.3 The maximum period for which a mining lease can be granted be fixed at 30 years for all minerals. Further, a mining lease should be renewed once, at the option of the lessee, if the lessee had fulfilled all the terms and conditions of the lease.

2.4 In order to discourage the holding of large leases without adequately exploiting the area, the dead rent should be increased in steps at specified rates during the lease period.

2.5 The Central Government should examine thoroughly the possibility of reduction in number and standardisation of forms for submission of periodical returns to various Government agencies.

2.6 The maximum area in one State to be held on prospecting licences by one person should be 50 sq. km. (instead of 50 sq. miles as now) and on mining leases should be 10 sq. km. (instead of 10 sq. miles as now).

2.7 Royalty rates should not be linked with pit-head prices. In particular, the present upper limit on royalty of 20% of the pit-head price should be removed.

2.8 The Central Government should take appropriate action if any State Government fails to implement within reasonable time the orders of the Central Government passed in revision of a State decision.

In many areas, the Geological Survey of India has carried out, on its own, proving operations much more detailed than is normally done. When these areas are leased for exploitation, the State Governments should ensure, to the extent possible, the recovery from the lessee of the additional expenses incurred by the GSI.

3. **Comments of Investigating Team**

3.1 Uncertainty in the prospect for renewal of the lease was mentioned most often as the cause for hesitation on the part of the mine owners to make invstements in mechanisation and in beneficiation plants. Some mine owners even expressed the apprehension that leases might be terminated before the expiry of the term for which they were granted in order to serve political ends. Conscious efforts to create a climate of confidence and making the first renewal of a mining lease almost automatic, provided the lessee has satisfied the terms and conditions of the lease, would appear to be needed if the mining industry is to be motivated to become more efficient.

3.2 There seems to be an element of unreality, and consequent room for suspicion on its application, in the provision for taking into consideration various factors when deciding between the applications received on the *same date*. Considering the information and documents to be submitted with an application, it would appear that only rarely would two applications be received on the same day. However, not only the legislation but also the proceedings at the meetings of the Mineral Advisory Board give great prominence to the applicability of this provision. Additional factors have been recommended for inclusion in the matters to be considered in resolving a dead-heat. Either all this is

waste of time or a sufficiently large number of cases are decided on this basis. If the latter is true, there is room for suspicion that somehow things are being manoeuvred such that those situations arise frequently.

It follows from the previous paragraph that it may be equally equitable, and perhaps more straight forward, to provide that applications for leases will be accumulated over a period, say a quarter, and considered together. This procedures may put the applicants on their mettle, inducing them to prepare well thought out programmes for exploitation of the lease area. As already mentioned many State and Central officials are in favour of a procedure which will give more assurance that the mineral resources will be worked to the greater benefit of the country. Decisions on the award of the leases can be taken by a committee consisting of technical experts working within carefully drafted rules for decision. Needless to say, the decisions must not only be, but also be seen to be, fair.

3.3 The implementation of the intent, expressed in paragraph 2.9 above, to recover from a subsequent lessee the additional costs for detailed proving operations carried out by the Geological Survey of India, would require, again, a violation of the first-come first-served principle for the granting of mining leases.

3.4 There certainly is a case for rationalisation of the requirements for submission of returns and other information to the various authorities concerned. This should not start with the assumption that all the information now being sought is necessary and that the need is only to put these in a fewer variety of forms. A comprehensive study should identify the information needs of the authorities concerned for the purpose of discharging their responsibilities, the information they can handle effectively, now and in the foreseeable future (say, ten years), the information that would be useful after this period even were it not to be used in the intervening years, and the information that mine owners can provide with adequate reliability and consistency and with effort commensurate with the scale of their operations. It is only after such a study had been completed that the information to be sought from mine owners decided upon. The design of forms for the submission of returns should then follow, aimed at the reduction of effort needed on the part of the mine owner, consistent with the requirement that the concerned authorities should be able to retrieve the information they need without undue effort.

3.5 The pace of examination, by the Central Government, of recommendations made by various committees at Mineral Advisory Board meetings, and of implementation of those accepted, appears unsatisfactory.

CHAPTER II—EXPLORATION

1. Exploration is discussed under three heads—

   (i) General investigations for locating and assessing the country's mineral resources ;

   (ii) Prospecting for the purpose of guiding decisions on investment in mining at a location ;

   (iii) Detailed exploration, for the purpose of planning mine development and expansion.

2. General Investigations

2.1 All over the world, this usually is an activity which is sponsored by the Government, if not undertaken by it. In India the Geological Survey of India (GSI), a unit under the administrative control of the Department of Mines of the Central Government, has been given the responsibility for mapping the geological features and locating mlneralised zones. Its organisation and work have been detailed in Part III, Chapter II.

The GSI has covered, by systematic geological mapping, about half the area of the country. Another 40 per cent of the country is covered by alluvial plains of major rivers and the Deccan Traps, areas of low significance in respect of mineral deposits. The remaining 10 per cent is planned to be covered by 1979.

2.2 The increasing urgency of locating and developing domestic resources of base metals had led to "Operation Hardrock", the project taken up with financing by USAID and with the technical collaboration of a U.S. firm. A total area of 90,000 sq. km. in parts of Andhra Pradesh, Bihar, West Bengal and Rajasthan was covered by air-borne geophysical surveys. A programme for ground follow-up is to be completed. Two air-borne surveys of somewhat different character, one whith French assistance and the other with U.S.S.R. assistance are to be taken up shortly.

2.3 Geological departments in the various States have augmented the GSI's effort and have also undertaken detailed work, amounting to prospecting, in areas of promise in the respective States.

2.4 While all this indicates considerable activity, it would appear that there is scope, and need for improvement. The Estimates Committee of the Fourth Lok Sabha, in its report of April, 1970 on the GSI, recommends acceleration of the activities and orientation of the work towards developing information rapidly on mineral deposits of critical importance to the country.

The Estimates Committee has expressed dissatisfaction, voiced by the mining industry also, that reports by the GSI on its investigations are not published in good time, resulting in time lag between discovery and exploitation of mineral deposits.

3. Prospecting

3.1 The term 'prospecting' includes activities by the GSI, Indian Bureau of Mines (IBM) and State geological departments in proving operations involving pitting, trenching and drilling, and the work of prospecting licences.

3,2 Prior to 1953, the GSI had a Drilling and Mining Department, which carried out proving operations independently, or on behalf of sponsors. In 1953, the IBM, which had been set up in 1948, was entrusted with the function of "conducting drilling and other prospecting operations to prove and estimate the workable reserves in mineral deposits and to conduct test mining independently or in conjunction with other Government or private organisations". In the period 1953-66 the IBM had carried out proving operations in a number of deposits of various minerals, chiefly at the behest of the Central Government.

3,3 As the Government was of the opinion that there was overlapping of the functions of the GSI in preliminary assessment and the IBM in proving operations, it decided to transfer the latter functions of IBM back to GSI. The transfer was effected in 1966, and the Drilling and Mining Division of the GSI was established.

3.4 Some of the State geological departments and a few large mining ventures (public and private sector) have organised prospecting units. The State units usually are small, and the captive units operate only in the minerals of interest to the parent body. Therefore the Drilling Division of the GSI may be said to be the best equipped unit available for sponsored work. However, even many public sector bodies which had benefitted from the work of the GSI have balked at the latter's charges. As of September, 1969, out of the amount billed by the GSI to four public sector bodies for services rendered, about one half had been paid, one fourth was in dispute and another one fourth outstanding.

There have been second thoughts in the Central Government about the wisdom of transferring the prospecting function back to the GSI. It was observed that the tempo of exploration was falling. At the same time, some of the public sector ventures were also thinking of winding up their prospecting units. Therefore, in 1969, the Central Government proposed that an independent "Department or Corporation of Mineral Exploration" be constituted. The Lok Sabha's Estimates Committee was of the opinion that merely forming a new agency would not solve the problem; it thought that the solution would be to keep the Drilling Division in the GSI, but reorganise it into an efficient, cost conscious and business-like unit.

It is reported that one of the recommendations of a committee set up by the Central Government to study reorganisation of the GSI is to separate the Drilling and Mining Division from the GSI.

3.5 The Committee on reorganisation of the IBM, which had submitted its report in 1967, had pointed to the practice in inuustrially advanced countries of having drilling and exploratory mining done through hired contractors. The Committee had suggested that this practice be encouraged in India, and until such time that reliable private contracting businesses offering this service are built up, the Government consider setting up, "merely as an interim measure", a Government-owned Drilling Company.

There is no indication that the Government has taken any steps to encourage the setting up of drilling and exploratory mining businesses in the private sector.

3.6 There are a few private organisations offering prospecting services on contract, as envisaged by the committee cited above. However, it is reported that there is little competition, and the prices quoted by these organisations are pegged to a value only a little below that the GSI would quote. Figures quoted are reported to be in the range of Rs. 200,000 to Rs. 400,000 per sq. km. These are much above what can be afforded by any but very large operations.

3.7 There would, then, seem to be deficiency in a very important input needed for the faster development of mineral activity in the country, viz. intensive exploration involving drilling. Filling the need might require action both in the public and private sectors.

3.8 A mining engineer in a public sector consultancy organisation, interviewed during the survey, expressed the opinion that the best course for an average entrepreneur wishing to carry out scientific prospecting (not involving deep drilling) would be to have this done by a university mining geology department willing to undertake such contracts. This practice is widely prevalent in advanced countries. where for students in advanced classes it served as good training during the summer vacation; they are willing to work at considerably less salary than a full fledged professional. It is necessary that the faculty assume the responsibility for the quality of the work. The engineer added that his efforts to promote this cooperation between the university and industry in India have been unsuccessful. The universities are apathetic, and even when any showed interest, the department was unwilling to guarantee performance. An added difficulty in India is that out-door work in the summer is not an attractive prospect.

The prospects for such cooperation were discussed at two universities. In one, the difficulty of fitting in the work with the university schedule was mentioned. In the other, work of this kind had been taken up occasionally, and there was an expression of continued interest in such work; the difficulty seemed to be in making a suitable arrangement with the client.

It is not out of place to mention here that university regulations and red tape in India make it impossible to make arrangements for similar contract work in any field, except when there is great determination on both sides.

3.9 The survey did not envisage interviews with prospectors. From discussions with mine owners, it would appear that prospecting done by the average mine owner without external assistance is of very elementary character. Regulations require that the prospector employ a whole-time or part-time geologist or mining engineer. Competent persons usually are not willing to be employed for this purpose. Many mine owners do not bother to prospect an area but go in directly for mining. In some of the mineral bearing area in the country, especially where the mineral can be won without much capital investment, this practice might not be less economical than prior prospecting.

3.10 The difficulty in locating mica-bearing pegmatites and assessing reserves has been mentioned earlier in discussing the status of mica mining. The IBM has considered the possibility of developing methods of estimating the chances of finding mica given the statistics on the findings of earlier prospectors and data on mines in the area. The main gap here would appear to be data on abandoned workings. This work would be worth pursuing.

3.11 There are several minerals in which there is need for detailed exploration at a rapid rate. Of particular importance are the base metals, chromite, manganese and kyanite. It appears that neither the public sector nor the private sector has the equipment or organisation to meet the needs of the country. Prospecting by smaller operators is also handicapped by the non-availability of qualified personnel or expert external assistance.

To remedy the situation, there is need for imaginative and determined action on the part of the Government. Equipment may have to be imported, suitable services in the public sector organised and the private sector motivated to fill the need. Fiscal measures could be devised to encourage proving activities.

3.12 This is an activity in which foreign financing and technical assistance can make a significant contribution, and through it to mineral development in India.

4. Detailed Exploration for Mine Development

4.1 The techniques involved in detailed exploration for mine development are much the same as for proving operations. The only difference here is that it is not done at the initiative of the Government but by the mine owner with a view to planning the type and scale of his operations. It points up the need for such services to be available on contract at reasonable rates so that the mineral is extracted in an efficient manner. On the one hand, efficiency implies better conservation of the resources. On the other, the mineral is extracted in an economical manner. As minerals are a basic resource of a country, cheaper availability of a mineral can have great impact on the economy of a country.

4.2 The survey showed that mining in the country, except perhaps by large ventures, can hardly be termed scientific. Among the services needed to tone up the industry is one that would assist the mine owner in exploring the reserves in his lease area, making improved assessments of the resources and developing information on the occurrence of the mineral so that an efficient mining technique can be devised.

4.3 The IBM started, in 1969, a technical consultancy service meant principally to assist the small mine owner. Among the services offered are proving operations of limited scope, consisting essentially of surface examination of existing excavations and exploratory data, and large scale mapping aided by a limited amount of pitting, trenching and drilling (shallow boreholes). The reason for poor utilisation of the profferred service by the industry is discussed in the Chapter "The case for a Mining Finance Agency".

CHAPTER III—MINING

1. Mining Methods

1.1 Among the minerals in which activity was surveyed, open cast mining is the method universally adopted in the case of iron ore, bauxite, chromite (except one mine in Mysore) and kyanite. Most of the mines in manganese ore are open cast, with a few underground mines operating in a big scale. In mica, a comparatively larger number of mines have underground workings. Mining in copper, lead, zinc and pyrites is all underground. Open cast mining is predominant in the mining of minerals not surveyed, except in the case of coal.

1.2 In open cast mines there are wide variation in the extent of mechanisation. On the one extreme, there are mines which are completely manually operated, and on the other extreme, there are mines which are fully mechanised. But, the percentage of the non-mechanised mines is much more than the mechanised ones. Factors governing mechanisation are long-term demand, richness of deposits, nature of soil, occurrence of ores, extent of overburden, etc.

1.3 At the bottom of the ladder, there are a large number of mines where every activity is manual; without even blasting done. In mines subject to water-logging, pump-sets are the only mechanised equipment used. At the next step, blasting may be adopted, with holes made by manual methods.

The first significant step towards mechanisation may be taken to be the induction of air compressors and pneumatic drills. In the classification of the methods of mining in the earlier Parts of this report, this is taken to be the definition of semi-mechanisation. Material is cleared manually; tubs are used in a few locations. The mined material is transported to a grading area. Size reduction and grading is predominantly manual. In manganese mining, hand jigging is used, and in fewer locations mechanical jigging is used. The

useable ore is transported to the stocking area, and the waste to the disposal area, mostly manually ; trucks and dumpers, if used, are loaded manually.

Use of mechanical methods for collecting the blasted ores, and loading these to transport vehicles would be the next step, and this and further degress of mechanisation are taken to qualify the mining to be called mechanised. Even in mechanised mines, by this definition, grading may be done manually.

1.4 In underground mines, pump sets for dewatering and blowers for ventilation are the first mechanical equipments used. Next come air compressors and pneumatic drills for blasting and mechanical equipment for hauling the extracted material. It is only in larger mines that tubs are used for transporting material underground and cages used for hauling workmen. Jack hammers are used in most of the mines. It is only in very large mines that any mechanical rigs are used for drilling. Mechanical motive power for movement of matetial underground is used in very few mines.

In the classification of underground mines in the earlier parts, use of air compressors and pneumatic drills is taken to qualify the mine as a mechanised mine.

2. Mining Requisites

2.1 *Electricity* : Mine owners everywhere have stated that provision of electricity can make their operations easier and more economical. Electrical drives are cheaper in first cost and need less maintenance. At energy rates applicable to industry in urban and semi-urban areas, operating costs of electrical machinery would be one-fourth to one-half of the costs with diesel or petrol machinery. However, power supply economics and certain technical difficulties tend to negate miners' expectations.

From the point of view of electricity distributing authorities, extension of electricity to mining areas remote from existing centres of consumption will be expensive, and if commensurate charges are levied the mine owners will find them unacceptable. There will be the problem of meeting the high capital expenditure needed. Even though mine owners have offered to make initial contributions towards the capital needs, it is doubtful that this contribution can be fixed at a level attractive to the electricity authorities. As a matter of policy, some of the authorities have determined certain rates for deposit and energy tariffs. As these usually are uneconomical to the authoriies, provision of these services have low priority.

Another difficulty in the provision of electricity service to mines is that the operations might move over a large area, requiring many machines to be portable. Even where this could be technically solvable, low standards of technical competence and safety consciousness could lead to accidents, and to disruption of service not only to the mine but to a much larger area.

On the other side of the coin, one of the priorities in improving the quality of mining would be the setting up of ore dressing plants. Availability of electricity would facilitate this, and the ore dressing plant would be a steady load, the preferred kind of load.

Underground mines probably are in a better position to make good use of electricity, for hauling equipment, dewatering pumps and illumination.

Among the mining units surveyed, 20 per cent of mechanised and semi-mechanised mines, and 40 per cent of non-mechanised mines did not have electricity service available. As the mines surveyed were among the larger mines in India in the minerals of interest, the percentage of total mines in India not having electricity facilities available, would be considerably higher.

2.2 *Mining Equipment :*

The most common type of mechanisation is seen in use of compressors and drills. Capacity of drills varies widely. While some drills can bore upto 3 feet, there are drills with large capacity which can bore upto 40 feet. Drills may be hand held or machine operated. Mines with a very high level of production use the drills of latter type.

Procurement of certain mining machinery and equipment and spare parts has become difficult because of restrictions imposed on imports. In order to patronise indigenous manufacturers, import of some machineries like bulldozer, drill master and shovel has been restricted. But the mine owners complain that these indigenous manufacturers are not able to supply the requirements in a reasonable period of time. Further since their capacity is lower than and quality is inferior to the imported machinery, the mine owners find them very much uneconomical. Same is the case with spare parts. Difficulties are also experienced to get import licence in time and this in some cases has created a lot of problems to the mineowners.

2.3 *Explosives* : There is no uniformity in the use of explosives among the surveyed mines. Mines having soft soil use very little explosive. Similarly necessity for using explosives is not felt in mines dealing with float ore. Iron ore mines account for the maximum consumption of explosives. The most popular of all explosives is gelatine. In more than 68% of the surveyed mines gelatine is either used predominantly or exclusively.

The other types of explosives which are used include Ammonium Nitrate, Oxygen, GNI and other slurry explosives. Except the procedural difficulties involved in getting a licence and in renewing it, non-availability of explosives has not been considered as a major problem.

2.4 *Mining Personnel* : There is no major problem regarding the availability of personnel, technical and non-technical except in base metal mining. As the

mining of base metal in India has started only recently, technology and expertise are not yet fully developed.

There are seasonal variations in the availability of unskilled labour in certain areas during peak agricultural seasons.

3. Ore Processing and Beneficiation

3.1 Ore obtained from mine is brought to various sizes in different grades so as to meet market specifications. In order to upgrade ore, beneficiation is under taken. Washing is the earliest method of beneficiation. Research has brought to light quite a few other methods. These are heavy media separation, jigging, drying, floatation and magnetic and electrostatic concentration. Except in a few fully mechanised mines, beneficiation of ore is done by manual methods.

3.2 For utilisation of fuels, agglomeration is undertaken. Out of the four methods of agglomeration viz. nodulising, briquetting, sintering and pelletising, only the last two methods are used. So far, in India, agglomeration has been confined only to iron ore.

4. Planning and Lay-out of Mines

4.1 With the exception of a few major units (including the captive mines), it may be generally said that working of the majority of the mines are characterised by lack of systematic exploration, planned working (in relation to layout, disposal of overburden, etc.) and programmes for future development. Let us take the case of disposal of waste and over burden. In general, in majority of the mines, waste and overburden are disposed of near the working pits. There have been cases where the overburden had to be shifted from the original dumping place so as to exploit ores there. The reason, however, why the overburden is not disposed of at a safe distance within lease area is the high transportation cost involved in that. Disposal of wastes near the working pits not only blocks the ore body below the overburden but also sometimes proves dangerous to the working of the present mines. A number of accidents, including a few fatal ones, have been reported to have resulted from unplanned disposal of the wastes.

4.2 The major reaso generally put forward by the mineowners for lack of present and future p ning are first, comparatively short period of the lease (20 years for most of the minerals) and difficulties associated with renewal of leases. Cases are reported where even the first renewal is delayed by 3 to 5 years. This problem has received a new dimension in recent years with increasing participation of the public sector in the mining industry. The private mineowners complain that wherever the public sector, particularly the State Government, is interested, they experience difficulty in renewal of leases. The second major reason pointed out by the mineowners is dependence on offtake by MMTC for exports. Because, MMTC does not enter into any long-term contract with the mineowners, production in each year is dependent on offtake by MMTC during the same year. This infuses an element of uncertainty in mining and acts as a disincentive towards long-term planning.

CHAPTER—IV TRANSPORTATION AND MARKETING

1. The characteristics of transportation to the market, in the case of domestic sales, or to the port, in the case of exports are discussed under the various means of transportation in use.

2. Transportation by Road

2.1 Except in the case of large operations having railway sidings within the property or using belt conveyors or aerial rope-ways for transporting the ore to the rail head or barge jetty, some transportation on public roads is involved in the movement of minerals. As the minerals surveyed, except mica, are high bulk commodities, transportation over long distance usually is by rail. Transportation by road is limited, as a rule, to the nearest point of railing or barging and to the market if it is close at hand.

The distribution of road hauls between mines and the rail head or barge jetty, as the case may be, is given below. The few cases in which the ore is transported by truck all the way to the port or market have been omitted :

Distance Range (km.)	No. of mines
0—4	14
5—9	23
10—19	21
20—49	29
50 and above	9
Total	96

2.2 A large number of mines, especially the smaller, hire trucking contractors for transport of the produce. Shortage of truck transport was not reported in any of the areas surveyed. The problem universally was the poor condition of the roads, resulting in high trucking charges. Trucking charges range from Re. 0.25 to Re. 0.50 per tonne-km. In the case of low value commodities, for example iron ore, bauxite and even manganese ore, hauls of 5 to 20 miles could make the trucking cost as high as the mining cost of the mineral.

2.3 Public roads in the mining areas are built and maintained by the State. Road building and maintenance have until now received low priority in the allocation of funds by States. As a result mines off the beaten path are served by poor roads, often just a track with no surface treatment. Many of these roads are impassable after heavy rains, thus curtailing mining activity in the wet season.

2.4 Estimates of saving in trucking charges realisable with roads improved by one or two grades have ranged from 20 to 30%. Mineowners hiring trucks say

that there is sufficient competition so that trucking charges will come down with improved roads.

2.5 The 'Study of the Domestic Transport of India's Export Cargo' completed by the Operations Research Group in March, 1971 (for the Ministry of Foreign Trade, and financed by USAID), has shown that in India, the expenditure on road construction and maintenance was only 35.5% in 1968-69 of the total revenue derived that year in the form of taxes and excises on diesel oil, motor spirit, motor vehicles and spares, customs levies on imported vehicles and parts together with State revenues derived from the road transport industry. The expenditure-revenue ratio had declined steadily from 65.8% in 1960-61. In sharp contrast, Japan spent about 140% of its revenue on roads in 1969.

2.6 The study cited above also showed that the States spent on roads only marginally less than what they received as revenue from road transport in the years 1964-68. Earlier they had spent more. In 1968, the Centre spent only 14% of the revenue it derived from road transport on road development. Therefore, there would appear to be a good case for Central assistance to the States in road building.

2.7 The Minerals and Metals Trading Corporation (MMTC) has financed the construction or improvement of some roads over which ore marketed by it is transported. This certainly is a commendable endeavour, but such assistance has not been available in many areas in the country. Also there are only a few minerals of interest to MMTC at present.

2.8 The case for States spending more on roads in the mining area would have to rest, if a purely financial analysis is made, on the net addition to the States' revenues that it can bring about. The State derives revenue from royalty, sales tax, surface rent and other cesses. The analysis would be complex, requiring estimation of additional mineral production that would occur. However, if external financing were available, the States might be willing to develop roads. In the Chapter on "The case for a Mining Finance Agency" it is suggested that road building might be an activity the agency could finance after careful analysis.

3. Transportation by Rail

3.1 Long distance movement of minerals usually is by rail. The rail-road network in India is quite extensive. For high bulk (in relation to value) commodities, such as ores or concentrates, the railway is the cheapest mode of transportation. However, the railways, owned and operated by the Central Government, have been increasing the freight rates almost every year in the past few years, as their net earnings have been insufficient to return appropriate dividend to the Central revenues. As a result the delivered cost of ores to home markets

as well as ports for export have been increasing, affecting domestic industrial economy and the export trade.

3.2 Concessions are offered by the railways for certain movements. Manganese ore moving to ports for export and to domestic ferro-manganese plants are given a small discount (6%). Iron ore from northern Rajasthan to Kandla Port and from an area in eastern Madhya Pradesh to Bombay, for export, is moved at lower rates. Special rates prevail for movement of iron ore from the public sector mines at Bailadila and Kiriburu to Vishakhapatnam for export.

3.3 An understanding of the impact of railway freight on the economics of mining can be obtained from the following figures. In the case of iron ore, a rail haul of 45 km. attracts freight cost equal to the mining cost. A rail haul of 550 km. absorbs half the f.o.b. price of exported iron ore. In the case of manganese, the average mining cost in open cast mines is equal to the railway freight over 400 km. In export of low grade manganese ore, half the f.o b. price will be taken up by the freight cost if the ore is transported by rail over a distance of 660 km. In the case of bauxite, a rail haul of 250 km. approximately equals the cost of mining the mineral.

3.4 The Vasudeva Committee on Manganese Ore, in its report (1965) has recommended that movement of ore to beneficiation plants be charged at a concessional rate in order to promote the practice of beneficiation. This could encourage the setting up of cooperative or custom beneficiation plants to serve number of mines. Such operations are non-existent in India today.

3.5 Proposals have been made, in various parts of the country, for rail links that have promise of making ore movement easier and/or cheaper. The Government is reported to be making careful studies of the costs and benefits of these proposals. Inadequate information on the reserves in the concerned areas is reported to be a handicap.

Long railway links, involving large expenditure, certainly deserve careful analysis before an investment decision is made. In the discussion under "Orissa" in Part VI the case is presented for a link which appears to be capable of conferring immediate benefit, and at the same time will fit in to either of the two large schemes now under examination. There might be room here for examination of the priorities assigned by the railways.

3.6 The major problems with rail transportation are. (i) service lagging behind demand, resulting in piling up of stocks at the rail head, and (ii) mismatching of service with demand and terminal characteristic.

The former is generally referred to as "wagon shortage". The problem has become very acute in the high production districts in Bihar and Orissa. The railways state that there is no shortage of wagons in number, but due to the unsettled conditions in the eastern region freight movement has been disrupted

grievously. This region has the highest density of freight movement in the country, and most major routes have been electrified in the past decade. Complicated signalling and communication systems have been installed to facilitate handling of the traffic. Due to the unsettled conditions prevailing in the area for the past two or three years, pilferage of copper overhead wires and cables (usually used in the signalling systems) has been on the increase, and thus has hampered movement of freight trains and empties. In addition, wagon looting and vandalism also have increased, and a large number of wagons have to be taken out of service for repairs. Wagon shortage was reported also in the bauxite mining areas of Gujarat.

3.7 Uneven arrivals of wagons for loading result in the mine owner having to pay additional charges on two counts. When stocks pile up at the rail head he has to pay storage charges. When wagons arrive at a rate faster than he can load, or transport the ore to the rail head from his pit-mouth stocks, he has to pay demurrage on wagons he keeps waiting beyond a specified period. Uneven arrivals have been reported almost everywhere.

3.8 Mechanical loading facilities ase used at very few locations, and usually they have been installed by a large producer or the MMTC. However, it was reported that manual loading of wagons did not offer difficulties except when wagon arrival rate was far in excess of the usual.

3.9 The question of giving concessional rates to ore movements in general, or of special categories, is to be considered from the point of view of national economy. The provision of service to match the requirements, however, should be a serious concern of the railways and it would appear that much needs to be done in this respect.

4. Transportation by Barge

4.1 Goa iron ore and manganese are almost entirly exported and the ores move to the port, Marmugao, on two rivers, the Mandovi and Zuari rivers, in barges. The man-made Cumbarjua Canal links the two rivers, and carries considerable traffic as the Zuari is the preferred channel. In the monsoon the Mandovi becomes hazardous for large movement, and all traffic is diverted to the Zuari.

4.2 At present, the Cumbarjua Canal is not navigable for about 8 hours, under low tide. The canal also lacks navigational aids to assist movement in the night. The mouth of the canal is not adequate for two-way traffic.

4.3 "The study on domestic movement of export goods", cited earlier, has recommended the widening and deepening of the Cumbarjua Canal, at an estimated cost of Rs. 13 million. Provision of illumination along the canal will make possible a changeover to 1000 tonnes barges, more economical than the currently prevalent 500 tonne barges. Considering this saving as the benefit, the internal rate of return for investment in improving the Canal has been computed as 25%.

5. Marketing

5.1 Among the surveyed minerals, developments in four—copper, lead, zinc and pyrites—have been tied in with processing operations, and therefore, these minerals are not of interest in the discussions of the marketing pattern. Exports of iron ore and manganese, except from Goa and the case of Manganese Ore (India) Ltd., are canalised through the public sector trading agency, MMTC. Domestic public sector steel plants also use the services of the MMTC to procure their requirements not met by their captive mines. In the other minerals domestic sales have been reported to be chiefly direct sales to the consumers.

5.2 Problems with marketing channels of the various minerals covered by the survey have been discussed under the respective heads. In iron ore, the MMTC has acquired a dominant role in the procurement of iron ore for the domestic market, in addition to having the monopoly for handling exports except from Goa. Mine owners have complained about the inability of MMTC to lift blue dust, whereas blue dust exports from Goa, done privately, have shown an increasing trend. In manganese the export market has revived in the past two years, and perhaps as a result there were few complaints from the producers. In mica, large export operations have control of the market, and the small mine-owners producing low quality mica in Rajasthan experience difficul y in getting a fair return.

5.3 On domestic marketing, a complaint heard often from producers of many of the minerals was that the domestic consumers prescribe unnecessarily rigorous specifications, resulting in the wastage of usable material. However, it would be only fair to point out that consumers would be willing to relax specifications, which would make the material cheaper, if they were sure that they could do so without affecting their output or economics adversely.

It might be possible to rectify the mismatch in one of two ways beneficiation of the ore, and modification of the specifications by research into the process consuming the mineral. The former has been discussed under the Chapter on mining. The latter is of different character. Large consumers, especially those operating in sophisticated fields, might be doing or sponsoring such research. In the case of industries in which smaller units prevail there is need for research by competent institutions. Such research could be sponsored by the mining industry, consuming industries or the Government. Adequate facilities for and interest in such research appear to exist in research institutions interviewed.

5.4 There is need for research also in new uses for the various minerals. The manner in which well-conducted investigations can lead to greater return for the mineowner as well as contribution to the economy is illustrated by the work on fuller's earth, conducted at the Regional Research Laboratory, Hyderabad.

5.5 Fuller's earth derives its name from its use in degreasing wool—termed fulling. RRL found that the material going under this name could be further classified into four compositions. It was found that the degreasing action was due to certain characteristics of the micro-structure of the components. Selected compositions could be processed by treatment with acid and heating to act as efficient "absorbers" of impurities in oils; one type of processed material could be used as a bleacher of vegetable oils, another to remove unsaturated compounds from lubricating oil cuts, reducing their corrosive properties. These media are being imported now. An entrepreneur has been licensed to set up a plant to produce a variety of processed media for different applications of this kind. With this enlargening of the market for fuller's earth, mine owners stand to benefit.

5.6 In acquainting the mining industry of the scope for research, financing such studies and promoting the establishment of new consuming industries, a special mining finance agency could play a useful part

CHAPTER V—CREDIT AND CAPITAL FINANCING

1. The experience and problems in securing loan finance by mining ventures are discussed under two heads—credit and capital financing. The term credit is used for the short term loans required by the industry. These loans usually are sought to be secured on hypothecation of stocks. The term capital financing is used for long term loans required by the industry for making capital investments in the development of mines, purchasing of machinery, etc.

2. Credit

2.1 Credit is extended to mineowners by commercial banks on hypothecation of stocks. The credit may vary from 50% to 80% of the value of stocks. Interest rates reported are around 9%. Apparently banks do not accept future production as a pledge ; only mineral already mined and stocked is accepted

It is only in the last year or two that bank credit has been available generally for all minerals, and whether for export or domestic sales. Formerly, banks were very selective in extending credit on mineral for domestic sale. Extra credit facilities were available for exporting mines, with the assistance of the Government.

2.2 The MMTC also extends credit on mineral pledged to be marketed through it. Formerly, MMTC contracts were on f.o.b.t. basis, and there was a significant interval between the mining of the mineral and realisation of its price. However, with the MMTC moving towards ex-mine contracts the mineowner can look forward to the realisation of the full price very soon after the mineral is mined.

2.3 Even though commercial banks are becoming less conservative in extension of credit, certain practical difficulties stand in the way in respect of certain classes of mines. In the case of mines in the interior, to be approached only over difficult roads, banks are unwilling to make the effort needed for verification of stocks. In the case of mica mines, the difficulty of assessing the value of the stock is a serious handicap. Both of these difficulties compound the problem of marketing for Rajasthan mica mineowners. The mica market is controlled from Bihar, and without adequate credit Rajasthan miners are often forced into distress sales.

2.4 The principal requirement for improving credit facilities available for mining would appear to be improvement of roads so that remote mines become more accessible. The need for improvement of roads in mining areas has already been stressed from the point of view of transportation of the product. Availability of credit will improve further the marketing position of the mines.

3. Capital Financing

3.1 Long and medium term financing for capital investment in mining has not been available to any but the large mining operations, which usually have affiliations with more stable ventures. It is understandable that the over-conserative Indian commercial banks have shied away from lending to the "risky" mining industry. The regulations controlling the functioning of the industry also have played a part. However, evidence also points to a lack of entrepreneurship and enlightened exploitation of minerals on the part of the industry.

3.2 Bankers and mineowners have cited the short terms of mining leases as a factor in the inability of miners to secure term loans. The statutory maximum durations for leases are thirty years in the case of coal, iron ore or bauxite and twenty years in the case of all other minerals.

Earlier it has been stated that, due to various factors, prospecting done prior to commencement of mining is of elementary character. Therefore it is doubtful whether a new mining venture can provide adequate evidence of its potential, to satisfy a bank. It is perhaps only after a few years of mining at the rate he can afford from his own sources, or funds he can raise from other sources, that a mineowner can think of approaching a bank. This usually will be for an expansion of his activities, perhaps by acquiring some machinery or, if an underground mine, opening new approaches. The term then left on his lease may be inadequate.

The wording of the provisions in the MMRD Act and MCR relating to renewal of a mining lease give the impression that the intent is to allow one extension of the lease, for the same period as the first, as a matter of course on application by the lessee, provided he has operated his lease in accordance with the regulations. A second extension requires a determination by the Central Government of its desirability. It is also reported that the first extension is

conventionally treated as automatic, provided the lessee makes the application. However, banks cannot be blamed for not recognising much a convention. Many cases have been repored of dilatoriness by States in awarding the first extension, especially where there is an intention to exploit the resources in the public sector. A committee appointed by the Government has recommended that *all* leases be for a period of thirty years and that it be provided that the first extension be granted automatically at the option of the lessee. It is understood that a decision has been taken to make the period of all leases thirty years, but that there are difficulties in accepting the recommendation on automatic extension at the option of the lessee.

3.3 The mining industry has, for some years, advocated the setting up of a Mining Finance Corporation to meet the specific needs of the industry. The Department of Mines and Metals has also subscribed to this idea. It is reported that the Reserve Bank of India and the Ministry of Finance are not convinced of the necessity for the establishment of a separate financing body. The Industrial Development Bank of India (IDBI) has been instructed to examine whether it, in cooperation with other existing financing channels, can meet the needs of the industry, and what changes, if any, in the environment and structure of the of the industry are desirable to achieve this end.

3.4 In a discussion with the IDBI, it was understood that the IDBI thinks that under the existing regulations and practice, a charge *cannot* be created on a mining lease. One reason cited was the possibility that the mining lease could be revoked on any one of several counts. Apparently, IDBI would be satisfied if the State Government would give a written assurance that a lease would not be cancelled in a manner affecting the interests of a recognised financial institution that may have lent money to the venture. It is understood that the Central Government will take steps to implement this requirement.

It was gathered from the discussions with IDBI that it is very reluctant to give loans to individuals and partnerships, and is selective even with respect to private limited companies. If this were to hold, a large part of the financing needs of the mining industry cannot be met by IDBI, at least directly. Individuals and partnerships predominate in the industry, though the larger units tend to be private limited, public limited or public sector companies.

The IDBI also undertakes refinancing of loans given by State Finance Corporations and commercial banks. It is possible that financing may be available through this route for the class which cannot secure direct loans from the IDBI.

3.5 State Finance Corporations generally are less conservative in their operations. Several of these have formulated schemes open to miners. Another factor, which will improve the picture in respect of availability of capital financing, is the recent action of the Reserve Bank of India in extending the credit guarantee scheme for small scale industries to mining also. This guarantee is available to

institutions seeking to finance ventures in which the capital investment on plant and machinery is less than Rs. 750,000. A large part of the class of medium and small mining ventures will become eligible.

However, a mining venture is of a category considerably different from that of manufacturing industries. Capital investment in mining can take the form of detailed investigations to determine the reserve and plan operations, improvement of roads within the lease (and even of access roads outside, as miners in several areas have undertaken), development of the mine (not always involving purchase of machinery), studies to determine economies of beneficiation or purchase of machinery. The schemes that State Finance Coporporations hitherto have formulated invariably are based on mortgage of machinery or other conventional physical assets. It may be said that finance bodies have developed some experience in judging the merits of investment in manufacturing industries, but their exposure to the mining industry's operations has been much less. Therefore the impact of the RBI's extension of the credit guarantee is likely to be felt only gradually.

Another kind of difficulty has been reported in the context of financing mining operations – the case of the missing mineowner. To the miner who has very little of his own money invested in the operation, it may be more attractive to abscond than to stay and try to repair failures or tide over difficult times. Financing for purposes other than purchase of machinery or acquiring other tangible assests is open to loss in such an event. It is reported that this kind of risk is encountered also in financing small scale industries. The risk can be expected to be greater with the smaller operations.

3.6 During the survey, mine owners and representatives of industry organisations consistently maintained that adequate financing facilities were not available. On the other hand, it is reported that when the Reserve Bank of India asked for statistics on applications from the industry turned down by existing financing bodies, with a view to determining the scope for operations for the proposed Mining Finance Corporation, the response was poor.

It can only be speculated here whether the volume of applications would be convincing had the industry not been discouraged by earlier failures. Also it could be surmised that informal approaches were made prior to the submission of formal applications and the responses could have indicated the futility of the latter. The extension of the RBI guarantee has been very recent, and it is not known whether it has had adequate publicity. No mine owner queried during the survey showed awareness of the measure (the survey personnel were also ignorant of the move by the RBI).

3.7 The survey revealed that there are a large number of enterprising ventures which were thinking of expanding their operations or making them more efficient. The larger operations, especially captive mines and those which have

affiliations with operations in other sectors, often need no external financing. For measures such as mechanisation, involving acquisition of conventional physical assets with good resale value, financing from commercial or Government institutions might be available. The problem in these instances more often is in securing foreign exchange if the right type of machinery is not available from domestic producers.

In securing capital financing for other activities peculiar to the mining industry, even for acquiring physical assets such as machinery for ore dressing or beneficiation, difficulty in securing financing was reported even by large ventures. In the case of smaller ventures, both difficulty in securing technical assistance and consultancy and difficulty in securing financing were reported.

It would appear that there is a place for an institution with special responsibility in financing the mining industry, equipped with a competent techinical arm which not only would fill certain needs of the industry but also would stimulate greater and more efficient activity by various promotional methods backed by the promise of financing for viable ventures.

CHAPTER VI—THE CASE FOR A MINING FINANCE AGENCY

1. The merits of a special institution for financing mining, which would have a competent technical arm for evaluation, client-counselling and promotion, can be viewed from two stand points—one, the improvement in the mineral economy that it can bring about ; and two, the socio-economic benefits that might result.

When a mining entrepreneur considers expansion or improvement of his activities, he is faced with one or more of the following tasks :

(i) Securing a new lease, if expansion within leases he is already operating is not being considered, or if the project he is considering, such as mechanisation or setting up a beneficiation plant, will not be economical without a larger area of operation.

(ii) Securing an extension of his present lease(s), if required.

(iii) More intensive exploration of the lease area, for the purpose of determining whether greater production will be in his interest in the long run.

(iv) Planning expansion of mining activities—determination of mining methods, extent of mechanisation desirable etc.

(v) Determining the optimal beneficiation (including ore dressing) scheme.

(vi) Securing financing.

2.1 The problems connected with (i) and (ii) have been discussed elsewhere. It is possible that the support of a recognised financing agency can weigh in favour of the applicant ; but this need not be recognised here.

2.2 Very large ventures might have their own exploratory equipment and technical staff for carrying out detailed explorations as a regular part of their operations. However, such ventures are few. Several large operations, including public sector organisations, reported that external assistance would be required to carry out intensive exploration. The intensive exploration unit of the GSI is available for such work on payment of scheduled charges. The charges are considered high by the industry and quite beyond the means of all but very large units or units with considerable resources behind them. Usually payment for the service is to be made in advance of the work. External financing for such capital expenditure activity of the industry has not been available, nor is it likely to be available under any present arrangement.

It is reported that intensive exploratory services are offered by a few private sector organisations, but that their rates are also such as to require external financial assistance in the case of most operations.

2.3 The Consultancy Division of the IBM offers a wide range of services, including exploratory services of limited intensity, interpretation of data from explorations, planning mining methods, organising the activity, developing economical beneficiation schemes etc. The Division was set up principally with the intention of assisting the small entrepreneur. However, as reported by the IBM; the utilisation of the services by the industry has been poor.

An industry spokesman contended that the IBM's requirement that the estimated cost of the study requested be paid in advance was onerous. The Central Government was requested to look into the possibility of having IBM collect payment in instalments over a period of a few years, as the study would be a capital investment for the sponsor. It is understood that the Central Government has replied finally that no such arrangement can be made.

Another problem, recognised by the IBM, is that the small entrepreneur often is not capable of interpreting the findings of the study in his own terms—what action he should take, so that, given the structure of his operation, he would be financially better off than he is. True, an economic analysis will be made by the IBM. However, it may be expected that the IBM, with its statutory responsibility for development of mineral exploitation consistent with good conservation practice, may find it difficult to view the problem entirely from the financial stand-point that the entrepreneur would take. It would be understandable if the entrepreneur should hesitate to base his decision entirely on IBM's analysis.

2.4 Research laboratories established by the Central Government perform considerable research and development work of interest to mining activity. The

PART V

Central Mining Research Station, the National Metallurgical Laboratory (NML) and Regional Research Laboratories (RRL) are notable in this respect. The activities of these laboratories are outlined in a later Chapter of this Part.

Of particular interest to the entrepreneur looking to improve his operations would be the work on ore dressing and beneficiation undertaken by NML and the RRLs. They take up work on their own initiative or sponsored by clients. Scientists at these institutions assert, uniformly, that ore dressing methods, economically superior to the manual grading methods usually adopted, can be developed for almost any size operation. Here would appear to be the first choice for improvement of the quality of mining. However, only a few of the smaller operators had any idea that better methods of grading might be available, and hardly any one showed awareness of how they could get advice on it.

2.5 Earlier it had been mentioned that capital financing is needed by the mine owner for purposes other than acquisition of tangible assets. Therefore, any agency interested in financing the mining industry, in all its various needs, would need to employ a technical team to assess the merits of requests for financing. The analysis in the paragraphs above shows that an enlightened approach to financing the mining industry must recognise the need for, and provide, other inputs.

It is not advocated that the technical arm of the financing agency undertake investigations on its own in any of the areas in which services are available as described above. Rather, it would assess the merits of conducting the investigations and recommend financing, at subsidised rates if thought fit, for the investigations. It would assist the client to analyse the significance of the findings for his operation, in the light of its own peculiar characteristics. Any investment decision recommended as a result of this analysis would be all the more acceptable to the client as probably financing would be made available by the agency itself for the investment.

The agency could play an important part in making the consulting institutions responsive to the needs of the industry. It has been indicated that it is in the area of detailed exploration that the services available appear too expensive for a large part of the industry to afford. There might be good reasons for this. Drilling equipment is expensive, in initial cost and operation. Technical expertise needed to carry out competent work would have to be adequately compensated. However, the agency might be able to evolve standard scopes of service for various scales of operations, and for various types of mineral occurrences, that would generate adequate information for the purpose and yet be within an affordable range of cost.

It is not known whether the equipment available with the agencies offering exploratory services are operating at an economic utilisation factor. Increased activity stimulated by the financing agency might serve to bring costs down.

2.6 It was suggested that the financing agency might subsidise certain investigations. Exploratory investigations would serve to increase information available on the country's resources, which in the case of many minerals would be of considerable value. Better mining methods and beneficiation result in more efficient use of the country's limited resources. Subsidisation of investigations might be a cheap way of securing these benefits to the nation.

3. Mining in India is labour-intensive. Only very large open cast mines, chiefly in iron ore, can be said to be mechanised to an extent comparable with practice in developed countries. In underground mining, except perhaps in coal, the extent of mechanisation in the largest mines is far less than obtains in developed countries.

The provision of gainful employment to the country's large labour force is a problem attracting increasing attention. Therefore, the case for any measure that could result in the reduction of labour employed per unit of output in an industry must be analysed with care.

Mineral production must be considered as part of the infrastructure on which the country's economy is dependent, almost on a par with provision of such services as water, power and transportation. Any reduction in the cost of mineral production could result in the improvement in the economics of several industries, one or more steps remote from the mining industry. In industries of importance in the export economy of the country, improvement in our competitive position could bring about a large increase in demand.

Minerals themselves have considerable export potential. While certain minerals already have achieved prominence in this respect, others, for example, barytes and bentonite, are coming into the limelight. Therefore, there is good scope for the growth of export trade directly in minerals with reduction of production costs.

Minerals are a limited resource in any country. Conservation of the resource should be given adequate consideration. The scope for larger realisation of value from a unit of the resource as found should be weighed against any disadvantages.

3.1 Any scheme for financial assistance to the mining industry should provide for adequate investigation into the priorities to be assigned among the various activities for promotion in the overall interest of the country.

It has been stated that currently financing from the organised sector, commercial or Government institutions, is available almost exclusively for purchase of machinery. That is, mechanisation of production is the activity promoted. There are various levels of mechanisation. The first is the acquisition of a compressor and pneumatic drills, to replace manual effort in drilling holes for blasting. The next is likely to be the induction of trucks and dumpers, with

loading still manual (and unloading in the case of trucks). Mechanical loading, and perhaps provision of mechanical ore dressing equipment, may be the next step. The ultimate, in open cast mines, is the complete mechanisation of stripping of overburden, extraction of ore, material transportation, ore dressing and despatch from the mine.

It has been shown that there are several other activities in mining that need capital financing, and that can confer benefits of different character. Current financing encourages mechanisation, at whatever level, above any of the neglected activities. It remains to be seen whether the RBI's move in extending a guarantee will change the character of financing significantly.

3.2 In copper, lead, zinc and pyrites only large public or private sector organisations are active, and it will be so in the future. In iron ore, and perhaps manganese also, scope for the smaller operations may fall rapidly. In other minerals, especially in many that are achieving prominence in export earnings or import substitution, the smaller, labour-intensive operations will play a dominant part. There is considerable scope for improving their operations and making them more economical, and at the same time not affecting the labour force adversely. However, the first need of this class is expert counsel, backed by the financing that may be needed to implement the desirable changes.

A properly constituted mining finance agency can help avoid, in the mining industry, the waste of scarce inputs, including imported raw materials, which have occurred in the industrial scene by inadequately administered schemes for assistance to the small scale operator. An example may be taken of the production of poor quality electrical devices by the small scale sector using scarce copper and brass.

3.3 The pressing need, in many mining areas, for improved roads, has been highlighted while discussing transportation and marketing problems. Except for the MMTC, which has financed some road improvement in areas of interest to it, there appears to be no external financing channel for meeting this need. Among the various demands on the State's resources, road improvement usually has received low priority. Here is an activity which a special mining finance agency can promote. This would provide additional employment and at the same time benefit the mining industry enormously.

4. From the survey conducted, it has not been possible to estimate the volume of operations that the mining finance agency should anticipate. Only the large operations had well prepared schemes that they wished to implement. Public sector bodies and ventures with external affiliations, usually have good access to sources of financing. However, even they have difficulty with respect to many projects. For example, a large joint sector venture, with majority Government participation, expressed difficulty in securing financing for detailed exploration and construction of a beneficiation plant.

Smaller operators had only notions on how they could improve operations, but these were not backed by well designed plans and cost estimates. Lack of information and guidance was often cited as the reason.

4.1 An approach may be made from estimates available on the capital investment and rate of capital formation. As of 1968, the total investment in mining was about Rs. 4480 million, out of which investment in coal mining amounted to Rs. 3120 million. The public sector accounted for about Rs. 2250 million of the total investment, in coal and other minerals. Omitting coal and iron ore, the investment by the private sector in the other minerals is estimated to be about Rs. 600 million.

The same sources have estimated capital formation in 1968 in the mineral industry (including coal but excluding other mineral fuels and atomic minerals) to be Rs. 406 million, of which Rs. 358 million was in the public sector. Approximately two-thirds of the investment was in plant and machinery and one-third in land, buildings and construction. The investment in mineral fuels (other than coal) in the public sector in the same year was Rs. 262 million.

From the allocations made in the Fourth Five Year Plan document, it is estimated that the Centre must arrange for approximately Rs. 1500 million, to be invested by public sector projects under its control in mining activities (including beneficiation but not further processing) during the Fourth Plan, in minerals other than fuels and atomic minerals. The investment in coal by the Centre is estimated as Rs. 1100 million. In the private sector in coal, in which increase is expected only in the capacity for coking coal production, an investment of Rs. 430 million is anticipated (Annual Report, Department of Mines and Metals).

In the non-fuel minerals, if encouragement is given to the private sector to invest in minerals not adequately covered by the public sector, or in which the public sector is not interested, the investment rate can be 10 to 20 % of that of the public sector. This might amount to Rs. 30 to Rs. 60 million per year. Adding to this a part of the requirement of the public sector, the mining finance agency can expect a volume of business of Rs. 50 to Rs. 100 million per year in the non-fuel minerals.

The expansion in the private sector in the capacity for coking coal is expecting to occur mostly in the captive mines of the Tata Iron and Steel Company and the Indian Iron and Steel Company. There might be scope for the mining finance agency to extend financing for part of this investment.

5, There have been many suggestions, from the Government as well as industry circles, on the financing mechanisms that the finance agency could adopt. One is the subsidisation of investigations and consultancy services. The agency could finance directly or stand guarantee for financing from other channels. It has also been suggested that in a case where the interest rate offered by

another channel is not attractive, the agency could provide a subsidy to make up the difference between the offered rate and the acceptable rate.

Extending a guarantee and subsidisation of interest are two mechanisms which will generate financing from other channels and increase the total financing available to the industry. The resources with which the mining finance agency can be endowed, and the volume of demand from the industry, would indicate whether such mechanisms are needed.

CHAPTER VII—FISCAL MEASURES

1. Income Tax

1.1 In a number of countries, mining activity is accorded special consideration in the formulation of income tax laws and regulations. This follows recognition that mining is different from other industrial activities in many significant respects and therefore requires separate treatment. Part IV lists several provisions made in the taxation laws of Canada in specific recognition of the characteristics of the mining activity. The Indian industry receives a low measure of special benefits. There are two incentive schemes of importance, applicable to mining industries in common with others.

1.2 Mining in certain minerals (coal, lignite, iron ore, bauxite, manganese ore, dolomite, limestone, magnesite and mineral oil) has been recognised as a "priority industry", along with a large number of other industrial activities, and is eligible for a deduction of 5 % of the "profits and gains." (The Finance Act of 1971 has reduced the deduction from 8 % of "profits and gains" to 5 %).

Again in common with other "industrial undertakings", a new mining venture is allowed an investment rebate, deductible from its income for taxation purposes, of 6 % of the "capital employed" in each of the first five years of commercial operation of the venture. Prior to the Finance Act of 1971, the definition of "capital employed" was such as to mean the net worth of the company. The Finance Act of 1971 calls for exclusion of long term loans and debentures from the base, thus reducing the deductible amount.

1.3 Earlier, in 1970, two amendments to the taxation rules became effective, both conferring some benefits to the mining industry. One of them was a measure specific to the industry.

The Taxation Law (Amendment) Act, 1970, is of great significance to the mining industry, as it introduces into the income tax laws a provision for amortisation of expenditure on prospecting and mine development. An amount equal to one-tenth of the expenditure incurred is allowed to be deducted from the "total income" in the first year of eligibility and the nine following years. There

is provision for carry over of the left over part of the deduction if the total income in any year should be less than the deduction allowable.

The revised depreciation sehedule introduced in 1970 also confers benefits on the mining activity by prescribing higher rates of depreciation for plant and equipment used in mining. For example, the rate for earthmoving machinery and similar equipment has been raised to 30%. This is the rate obtaining in Canada. However, the Indian rules allow only 10% for mine shafts, etc., whereas Canadian rules allow 100%, i.e. such work is considered revenue expenditure.

1.4 On the adverse side, the withdrawal of development rebate with effect from 1974, announced in the Finance Act of 1971, certainly will discourage investment on plant and machinery. It has been mentioned earlier that one of the preferable ways of improving the efficiency of the mining operation is that of establishment of beneficiation plants. The withdrawal of development rebate will inhibit the installation of beneficiation plants; mine development will be affected to the extent of the rebate not being available for the equipment installed in the mine. In addition, the prospects for establishment of service organisations for prospecting and intensive exploration have been diminished.

1.5 Thus, while 1970 brought good news to the industry, with some special note taken of its needs, the Finance Act, 1971, has been depressing. Perhaps before the withdrawal of development rebate there would be a net gain from the fiscal enactments of the two years, but is difficult to assess the net effect on mining after the withdrawal of development rebate. On machinery liable to rapid wear and tear, a higher depreciation rate is preferable to development rebate. It has been reported that under the conditions the development rebate is given, it is not possible to make full use of it as heavy mining machinery give only 4 or 5 years of economical service.

1.6 Depletion allowance is not provided in Indian income tax enactments. A depletion allowance could be obtained by negotiation with the Government, but this is likely to be effective only in very special cases.

Depletion allowance could be an effective instrument to secure rapid exploitation of minerals in respect of which, there is reasonable assurance that the country's resources are abundant, or the prospects for export earnings are so high as to permit a risk pending the proving of indicated resources. Iron ore and manganese ore could qualify.

1.7 Part IV (Chapter II, Section 5.2) refers to an interesting kind of venture not undertaken in India-prospecting with the intent of selling rights to exploit the minerals in claims proved to have exploitable reserves. Earlier in this Part, under "Exploration" the need for establishment of competent, well equipped prospecting services has been emphasised. A careful examination of the law is needed to determine whether ventures of the kind mentioned above, as existing

in Canada, can be set up under existing Indian Law. If not, it might be worthwhile to examine the pros and cons of allowing such ventures, and provide for their advent, if considered desirable, by making the necessary amendments.

1.8 The Appendix to this Chapter lists a number of possible incentives that could be given to the mining industry, and presents the situation in Canada, Australia and India with respect to each of the measures. Information on the Australian rules have been obtained from a similar statement presented by the Indian Mining Association, in its annual report for the year 1969. Information was not available for the study to allow verification of the Australian rules, especially whether they are currently valid.

2. Excise and Sales Taxes and Import Duties.

2.1 In Part IV it has been mentioned that in Canada almost all items of equipment likely to be used in mining activities are exempt from the consumption tax, which seems to be the composite of excise and sales taxes. It has been estimated by the Financial Controller of a large mechanised iron ore mine in India that the sales tax payable on mining equipment accounts for approximately 1 % of the cost of mining the ore. The excise and the sales tax together, then might account for about 5 % of the cost of mining the ore.

2.2 The exemption from these taxes of machinery and equipment purchased by mining industries playing a big part in the economy of the country could be considered.

2.3 Similarly, a case might exsit for exempting from import duties, on the pattern of Canada, items of essential need for the development of mineral exploitation in the country, for example drilling equipment and instruments used for investigations.

3. Rewards for Export Earnings

3.1 For the purpose of increasing the export earnings of the country, a large number of industries have been given 'entitlements' for the import of certain classes of goods. The underlying rationale that these industries use imported raw materials or components in the goods they export, and the entitlement allows them to replenish their inventories with these materials. In practice, the entitlements usually are on the generous side, and the owners are allowed to transfer them, in part or the whole, to others, under certain restrictions with respect to the beneficiaries as well as the classes of goods they can import. The licences are sold at a good premium.

3.2 Mining industries are not eligible for any such benefit, as the goods they export do not contain any direct imported input. Therefore, the indirect bonus that the eligible industries get, in the form of the premium received on the transfer of licences, is not available to the mining industry (in common with many others).

3.3 As has been pointed out earlier, mining is not being conducted in as technically competent a manner as one would wish, due to the cost or scarcity of certain inputs. Chief among them is intensive exploration needed for assessing the reserves and planning mine development. An important element in the cost of exploratory services is the cost of drilling equipment and spares, and the fact that most of these have to be imported. It would be seen, then, that such imports required for the mining industry could be subsidised to an extent commensurate with the export performance of the industry.

4. Impact of Taxation

4.1 The study team is grateful to the Financial Controller of a large mechanised mine, mining iron ore, in Orissa for a note on the impact of taxation and other levies on the cost of operation of the company.

4.2 The impact of various levies have been estimated to be as follows :

Levy	Percentage contribution to expenses.
(a) Royalty on mineral	15
(b) Royalty on timber	1
(c) Road tax (application of levy is under dispute in Courts)	17
(d) Sales tax on machinery and materials	1
Total for listed levies	34

APPENDIX TO CHAPTER VII

Statement comparing special incentives to mining in Canada, Australia and India

Incentive	Canada	Australia	India
1. Deductions, for income tax purposes, of prospecting and development expenditure.	Such expenditure in a year in producing mine or properties remote but limited to Canada are deductible from the profit for the year or can be deferred to future year or years.	Exploration or prospecting expenditure including geological mapping, geophysical surveys, etc. within limits are deductible under Section 123AA and captial expenditure on plants under Sections 122, 122A and 122B. In lieu of these deductions annual depreciation allowance is also allowed.	Exploration work, carried on regularly as part of the mining activity, is eligible for deduction as revenue expenditure. Prospecting and development work of a capital investment nature can be amortised over a period of ten years, and the instalment deductible, in accordance with Section 35 E of the Income Tax Act, introduced in the Taxation Law (Amendment) Act of 1970.
2. Depletion allowance deductible from income for income tax purposes.	33 1/3% of the profits of the mine (except in the first 36 months, during which no tax is payable).	—	Not available in India.

Incentive	Canada	Australia	India
3. Depreciation allowance deductible from income for income tax purposes.	Rates applicable are : (a) Mining machinery and equipment—30% (b) Mine Shaft, Main Haulageway or similar underground work—100%.	—	Rates applicable are : (a) Surface and underground machinery (except electrical machinery)—15% (b) Earth-moving machinery and portable underground machinery—30% (c) Trucks and tractors—30% (d) Electrical machinery, locomotives, rolling stock—10% (e) Mine shafts and inclines—10%.
4. Tax concessions in the initial years.	36 months exemption from tax, commencing with the day on which the mine came into production in reasonable commercial quantities.	20% of net income derived from sale of prescribed minerals, which include bauxite ores of antimony, copper, nickel, etc., is exempt under Section 23A.	Tax concessions are given to new industrial undertakings for each of the five successive years immediately following the year in which the undertaking began production or manufacture of articles or goods. Profits of such undertakings are exempt from both income tax and super tax upto 6% of the capital employed, excluding long-term loans and debentures.

Incentive	Canada	Australia	India
5. Miscellaneous.	(a) Bonafide prospectors and their employers or financial supporters are exempt from tax on amounts received from sale of property acquired.	(a) Special Government assistance for transport facilities, etc.	No other special incentives are provided.
	(b) Shareholders may deduct an allowance in respect of dividends in computing their income if 25% or more of the corporation income is derived from mineral profits.	(b) Price guarantee, such as in respect of copper, together with a bounty.	
	(c) Goods required for prospecting, mining and smelting are exempt from consumption or sales tax.	(c) Capital expenditure qualifies for exemption and shareholders in mining businesses are entitled to a 1/3 deduction from calls paid by them on these shares.	
	(d) Machinery, raw materials, etc., are admitted free from customs duty.	(d) Income from the sale of rights to mine and 20% of the profits from mining are exempt.	
		(e) Special exemption is available for income from sale of mining rights by the prospectors.	

Sources : 1. Indian Mining Association—Report of the Committee for the year 1969.

2. ORG Mineral Survey.

CHAPTER VIII

RESEARCH INSTITUTIONS IN MINING AND BENEFICIATION.

1. Central Mining Research Station, Dhanbad.

1.1 *Introduction :* The Central Mining Research Station (CMRS) was established in the year 1955. It belongs to the family of institutions organised by the Council of Scientific and Industrial Research to conduct various scientific, technological and engineering researches in the country. The CMRS came into active functional stage only in 1961. During the intervening period of about six years it was engaged in planning and construction of buildings and acquisition of equipment.

1.2 *Organisational Set-up :* The CMRS is headed by a Director whose office is at the Research Station at Dhanbad. As the Research Station conducts studies in various fields of mining such as technology, safety, engineering and health, it has as many Assistant Directors. There are also Assistant Directors for special studies like blasting and stowing.

1.3 *Functions :* The main objective of the CMRS is to investigate a wide range of problems bearing on the techniques and efficiency of mining operations and on health and general safety of the miners. The researches are also directed towards testing and certification of mine equipment as well as with the design and development of special apparatus.

The research activities of CMRS can be, thus, broadly classified under four fields of study (i) Mining Technology, (ii) Mine Safety, (iii) Mine Engineering, and (iv) Mine Health.

In the field of mining technology, the projects are (a) investigation of the suitability of roof bolting in mines, (b) investigation into the possibility of improving the operating efficiency and economy of hydraulic sand stowing installations in mines, (c) introducing pneumatic stowing in mines for the first time in India, (d) investigation on mine subsidence, (e) investigations of strata movements and strata control in mines, (f) investigation into strength and workability of coal, (g) operational research on mine working problems to increase the efficiency of various mining operations, etc.

In the field of mine safety, the major activities are (a) survey of ventilation conditions in mines and reorganisation of ventilation systems, (b) investigation of mine fires and spontaneous heating of coals, (c) consultation, investigation, development and testing services in respect of

(i) Flame proof electrical equipment for use in hazardous locations,

(ii) Intrinsic safety of electrical appliances and circuits,

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(iii) Permitted types of explosives, exploders and detonators,

(iv) Mine safety equipments like miners' helmets, caplamp bulbs and batteries, flame safety lamps, safety torches, methanometers, etc.,

(v) Mine fans, anemometers and velometers.

(d) Collection and analysis of mine air/gas, and (e) Chemical analysis of mine dust, stone dust, mine water, etc.

In the mine engineering field, the following services are offered to the industry ; (a) investigation, development and testing of wire ropes, (b) testing of roof supports such as hydraulic props, and timber props, (c) non-destructive testing of suspension gear components such as cappels, safety hooks, distribution plates, shackles, cage suspension chains, etc., (d) ultrasonic testing of winding engine shafts in situ, (e) metallographic analysis, chemical composition and heat treatment characteristics of material used in mining and allied equipments, (f) testing of cables in mines, dielectric strength of transformer oil and switch gear protective relays, and (g) testing of bricks and rock samples.

In the field of mine health, the investigations being undertaken are (a) assessment of air-borne dust in mines, factories, washeries, etc., (b) investigation into occupational diseases amongst workers, (c) study on work physiology of miners and (d) study of air-pollution problems using electron microscope.

1.4 *Projects and Consultancy Services :* The Central Mining Research Station takes up different projects either institutional or sponsored. The various sponsoring sources include defence and other Government departments, public sector corporations like NCDC, public sector industries, private sector industries and international bodies.

The charges for the consultancy services are calculated by the Central Mining Research Station on the basis of the actual expenses incurred. It is also understood that in case of some sponsors only 50% of the entire expenses is recovered as the charges. Whenever a project is taken up as of national interest, the Central Mining Research Station bears the entire expenses. But, here, the Research Station has definite plans to obtain know-how of new technological developments. For example in Gidi Mines (Karanpura Coal Field), the French experts were called and the mine was opened according to the French system of working. The total expenditure involved was borne fully by the Central Mining Research Station. At present the Research Station is working mostly on sponsored projects. As learnt from the Research Station, the number of sponsored projects is so high that it is not in a position to conduct research on institutional projects. This suggests that the charges are reasonable which attracts sponsors in large number.

1.5 *Achievements :* The Research Station has to its credit many contributions to the industry a few of which are mentioned below :

1.5.1 *Mining Technology :* Roof Bolting in Mines. The Central Mining Research Station has successfully introduced roof bolting in about 20 Indian mines. It is revealed that roof bolting is a better method of roof support as compared to the conventional practices. It has led to greater safety and productivity at the same time reducing costs of roof supports.

Stability of pillar at Zawar Mines. It was thought by mine safety authorities that Zawar Mine pillars may not be safe enough and may possibly require stowing for stabilisation. This would have involved an expenditure of several lakhs of ruppees. After three years of intensive observations and investigations by CMRS, it was revealed that the pillars were stable and did not require stabilisation.

Hydraulic Sand Stowing. CMRS carried out investigations in collieries working relatively flat seams lying at shallow depth. As a result the rate of stowing was increased well over 200% in some of the mines.

Pneumatic Stowing. In cases where sand and water required for stowing are not available or the mines are at low depth and/or have low gradient, the pneumatic stowing is proposed. The trials by CMRS proved to be successful. As a result the mine went into production once again.

Strata movements in Longwall Workings. Based on thirteen longwall workings in mines, CMRS gathered data for efficient introduction of longwall mining in Indian conditions. This will result into larger production and less loss of coal in mining.

Operational Research into Mine Working. Fourteen projects were sponsored by various Government and private organisations on problems of transport, timbering, mine workshop, pumping, production, sand gathering plants, rope ways, etc. It is claimed that the efficiency of operation and production were increased following the study by the Research Station.

1.5.2 *Mine Safety :* Investigation of Explosives and Detonators. The facilities for investigation of these items exist only at CMRS in India. Provision of these facilities has put the explosive manufacturing industry in the country in a position to manufacture and supply the requirement of the mining industry, thereby completely eliminating the imports. There is foreign exchange saving worth Rs. 27 million on explosives and Rs. 24 million on detonators. The country is self sufficient in detonators.

Ventilation Survey. Investigations of the ventilation conditions have been made in 42 mines covering 39 coal mines, 2 gold mines and 1 copper mine.

Reorganisation schemes for the ventilation of the mine for future extensions are also supplied.

Mine Fires. Investigation of State of fire and its control has been carried out in eight mines. A technique of isolation stoppings has been adopted. With this technique except the fire area, the rest of the mine can be worked for production. Also the optimum size of coal stacks are determined to avoid self-heating and fire.

Testing of Electrical Equipments. Over 200 equipments of Indian and foreign make have been investigated and tested. Provision of this facility has given a fillip to the indigenous manufacture of these items which were imported earlier.

Testing of Safety Equipment. Under this programme 30 batches of helmets were tested. Out of these 30, the different types were plastic 14 batches, fibre-cardboard 5 batches, aluminium 2 batches and fibre glass 9 batches. Six safety torches (1 foreign make and 5 indigenous) were tested. Caplamps (Lean acid type) also were investigated, which included 2 of foreign make. Six methonometers (5 foreign) and 7 flame safety lamps (2 foreign) were tested. About 23 different types of caplamp bulbs, over 200 anemometers and velometers were also checked.

1.5.3 *Mine Engineering :* Wire Ropes Investigations. The project is intended to promote and assist indigenous production of wire ropes by improving upon the quality of the product. The wire rope manufacturing industry has been utilising these services at large. The estimated foreign exchange saving on wire rope is about Rs. million per year. Now, Indian manufactured wire ropes are also being exported.

Mine Roof Supports. Investigation and development of mine roof supports, suspension gear components and safety-hooks, etc., has enabled indigenous manufacture of these items and enhanced safety in mining. The estimated savings in foreign exchange on mine supports is Rs. 1.5 million and on safety hooks, capples and other similar mining equipment is Rs. 0.8 to 1 million per year.

1.5.4 *Mine Health :* Airborne Dust Assessment. Assessment of airborne dust has been carried out in 15 coal mines, 12 manganese mines, 2 iron ore mines, 5 coal washeries, 14 refractories and 2 stone quarries. A study on lead dust problem in a lead smelting factory and the incidence of lead poisoning due to inhalation of lead dust are also completed.

Pneumoconiosis Survey. The CMRS is deeply engaged in the study of the incidence of pneumoconiosis—a disease contracted by miners due to inhalation of coal dust.

1.5.5 CMRS Designed Equipments. The CMRS has designed and fabricated a variety of equipments which are now put to use in the field. These instruments

include (a) Bench Model Methanometer, (b) Modified Graham's Pressure Surveying Apparatus, (c) Remote-indicating Hydraulic Load Cells, (d) Remote-indicating Convergence Indicator, (e) Roof-bolts, (f) Rigid-Type Convergence Indicator, (g) Suspension Type Convergence Indicator, (h) Strain-bar using Dial Gauge, (i) Strain bar using Vernier Calipers, (j) Rangind Road fitted with Vernier Scale, (k) Tow types of Hydraulic Load Cells, (l) Roof Bolt Load Cell (mechanical), (m) Roof Bolt Load Cell (photo-clastic), and (n) Borehole Extensometer.

1.5.6 The CMRS received cash awards from the Invention Promotion Board for development of (a) an improved process for the manufacture of carbon monoxide detector tubes which is under commercial exploitation, (b) Remote-indicating Hydraulic Load Cell, and (c) Remote-indicating Convergence Indicator.

1.5.7 Ths CMRS has already got 23 patents (upto 1968) of different items developed at its laboratories and has applied for 13 more.

2. National Metallurgical Laboratory, Jamshedpur

2.1 The National Metallurgical Laboratory (NML), established in 1946, is one of the national research institutions functioning under the control of the Council of Scientific and Industrial Research, now under the Cabinet Secretariat, Government of India. NML conducts research in processing of minerals and metallurgy. The Ore Dressing Division, with its Mineral Beneficiation Pilot Plant, at NML is the Division of most interest to this study.

2.2 The list of investigations completed by the Ore Dressing Division shows that the Division—took up its first project in 1950 and picked up momentum quite rapidly. By the end of 1957 it had completed, or had on hand, a little over 100 projects. It was at this time that the NML intiated a proposal for acquiring a pilot plant to assist it in the study of mineral beneficiation methods. The idea was prompted by the installation of a pilot plant for upgrading and utilisation of lignite at the Neyveli Lignite Project Tamil Nadu, provided by the U.S.A. under the Technical Cooperation Aid Programme. NML succeeded in obtaining the necessary financing through the U.S. Ex-Im Bank Credit Scheme.

2.3 The engineering design, lay-out, and erection of the Mineral Beneficiation Pilot Plant (MBPP) was undertaken entirely by the NML. The MBPP is claimed to be one of the most versatile in the world, capable of undertaking trials on mineral beneficiation and agglomeration of fines, with a capacity of up to 5 tonnes per hour of ore handling depending on the particular oredressing treatment and upgrading cycle required. The plant was inaugurated in 1963. The total outlay on the plant was Rs. 5 million, about half of which was in foreign exchange.

The MBPP is divided into various sections, viz. (i) crushing, (ii) washing and grinding, (iii) reduction roast and low intensity magnetic separation, (iv) heavy media separation, (v) flotation, (vi) gravity concentration, (vii) thickening, flltration and drying, (viii) electrostatic and high intensity magnetic separation, and (ix) sintering, briquetting and pelletising. It has its own facilities for preparing samples for sieve analysis, chemical analysis and petrological studies. The plant is installed on 6 acres of land, within which are a 1000 KVA electrical substation and a water treatment plant.

2.4 The Ore Dressing Division undertakes twenty to thirty projects per year. Twenty projects taken up in 1970 are reported to have been completed by the end of the year.

The Head of the Ore Dressing Division stated that in recent years all the projects have been sponsored projects. NML is planning to expand the Division as the requests for its services have been increasing. Beneficiation investigations not requiring a pilot plant study are completed in two to three months; pilot plant studies are completed in about four months. NML would like to shorten these times further.

2.5. The Ore Dressing Division offers a complete range of research and consulting services. Detailed economic studies are performed, including an evaluation by the Division's geologist of available data on the client's properties to assess the workable reserves and the period within which the investment should pay off. Flow sheets are prepared after pilot plant studies. The Division undertakes preparation of invitation for bids, technical scrutiny of the bids, inspection of equipment at the manufacturer's works and supervision of installation and commissioning of the plant. Such a complete service was offered for the Gujarat Mineral Development Corporation's fluorspar processing plant at Ambadungar. NML is performing similar services for the 1000 tonnes/day experimental project at the Rakha copper mines.

2.6 It was reported that there have been no complaints regarding NML's charges for work. In the early years the sponsors were not required to pay for the work. It was found that the sponsors took little notice of the work, and often did not even acknowledge receipt of the reports. After NML began to charge for the work, its report have been received with more respect.

It was stated that for large beneficiation projects where total investment is of the order of Rs. 10 million and above, NML's consultancy charges are not likely to exceed 1% of the cost of the project. For smaller projects, the charges may amount to 2 or 3%. The Ore Dressing Division's charges have ranged from a few thousand rupees to about rupees 100 thousand.

The Geological Survey of India is a big customer of the NML. Ore samples are sent to NML for determining whether they can be economically beneficiated.

GSI takes decisions on the desirability of intensive exploration on the basis of the results of such studies.

The Head of the Ore Dressing Division stated that simple mechanical (or partly mechanical) ore dressing schemes, that would be more economical than manual grading methods, could be designed for even small mining operations.

2.7 In a brochure on the MBPP, the NML lists the following as representative of the important beneficiation plants, planned or installed in the country on the basis of flow-sheets prepared by NML :

1. Iron ore treatment plants in the public and private sectors.

2. Graphite ore-dressing plant in Titlagarh, Orissa.

3. Fluorspar beneficiation plants in Rajasthan and Gujarat.

4. Iron ore sinter plants for steel plants of Hindustan Steel Ltd.

5. Ore-treatment plants for diamondiferrous gravel and tuff of Panna area, for the NMDC.

6. Beneficiation units for metallurgical flux quality limestone for steel plants in the public and private sectors.

7. Cooper-lead-zinc flotation plant in Sikkim for Sikkim Mining Corporation.

3. Copper flotation plant at Khetri, Rajasthan, for the NMDC. (Note : NMDC had the responsibility for developing Khetri before the formation of Hindustan Copper Ltd).

3. Regional Research Laboratory, Bhubaneshwar.

3.1 The Regional Research Laboratory (RRL), Bhubaneshwar, Orissa, is one of the regional laboratories under the Council of Scientific and Industrial Research, Cabinet Secretariat, Government of India. It was established in 1964, with the primary purpose of undertaking research and development work for the economic utilisation of the natural resources of the Orissa region.

3.2 The principal natural resources of the Orissa region are minerals, forests and marine life. Therefore the work of the RRL is devoted to the task of developing methods for improving the economics and efficiency of the utilisation of these resources. It is estimated that work on minerals will constitute 50 to 60% of the effort at RRL. When the present sanctioned strength is achieved, 30 to 40 scientists and an equal number of technical assistants will be working on mineral beneficiation projects.

3.3 The RRL has, so far, taken up projects in the mineral area in accordance with recommendations made by a Council set up by the Orissa State. No project has been sponsored by the industry. It is expected that as the laboratory

becomes better established, it will receive requests from the industry. RRL is keen to work on sponsored projects.

The practice has been that, whenever a promising process is developed, or an equipment designed, the rights for licensing it are given to the National Research Development Corporation of India, an organisation under the Ministry of Education, Government of India.

3.4 The RRL has done considerable work on beneficiation of chromite, iron ore (blue dust), manganese ore, limestone and graphite. In chromite the concentration has been on pelletization and briquetting. In addition to conventional pelletization of blue dust the preparation of self-fluxing, pre-reduced pellets by incorporating suitable solid reductants and fluxing agents has also been under investigation. Processes for reduction of the iron content and phosphorus content of low grade manganese ores are under development.

3.5 Of particular interest are the RRL's plans for deeper study into certain component processes of beneficiation.

RRL has estimated that size reduction accounts for about 60% of the operating cost of a beneficiation process. It is setting up size reduction laboratory with the purpose of developing more efficient designs of machinery and operations.

RRL has also taken up work in developing various types of fluid energy mills for drying, mixing, grinding and coating operations. One versatile design of grindling mill has been patented and consultancy is offered to Indian manufacturers in adapting the design to meet particular requirements.

Another process being investigated is that of cold pelletization as a cold pelletization plant is expected to need less capital than a conventional plant of equal capacity.

3.6 The Regional Research Laboratories at Jorhat, Assam and Hyderabad, Andhra Pradesh also perform research expected to lead to better utilisation o. the country's mineral resources. One aspect of such research, not stressed earlier, is the investigation of utilisation of minerals. It could be in determining whether use could be made of inferior grade material in existing utilising processes. It could be in the identification of the principal properties of the material being used which make it suitable for the end use, with a view to substitution with other material or developing other use for the material. An example of this type of research conducted in the RRL at Hyderabad has been cited in the Chapter on "Transportation and Marketing" earlier in this Part.

PART VI

Mining in India (by State)

CHAPTER I—ANDHRA PRADESH

1. INTRODUCTION

1.1.1 Andhra Pradesh possesses a wide variety of minerals which include copper, mica, lead, iron ore, manganese and coal. Mining and prospecting activities have exposed a wide range of minerals, some of which possess considerable potential for exploitation.

1.1.2 Andhra Pradesh ranked seventh in 1970 among the mineral producing States in the country. The State's contribution to the total value of major minerals produced in India was only 3.9%. There has been a steady decline in the State's share since 1969. The total production of major minerals in the country has registered a steady increase since 1966 from Rs. 2,917 million to Rs. 4,296 million in 1970. However, during the same period the total production of Andhra Pradesh has been around Rs. 170 million.

Coal most important mineral

1.1.3 Coal, by quantity and value, is by far the most important mineral exploited in Andhra Pradesh. Coal contributed about 85% by value to the total major minerals produced in Andhra Pradesh during 1970. The contribution of minerals under study to the mineral production (of major minerals) in Andhra Pradesh is small (1.4% in 1970) Table (1.1.1).

1.1.4 Among the minerals under study, mica, manganese and iron ore are the minerals mined in Andhra Pradesh. Mica and manganese ore contributed 43% and 44% of the total value of production of the minerals under study.

Table 1.1.1: Share of Andhra Pradesh in the Mineral Production of India Major Minerals and Minerals Under Study

(In million Rs.)

Year	Major Minerals			Minerals Under Study		
	India	Andhra Pradesh	% Share	India	Andhra Pradesh	% Share
1966	2,917.1	148	5.0	419.1	8.1	1.9
1967	3,317.7	163	4.9	449.0	7.8	1.7
1968	3,810.4	173	4.5	499.8	9.0	1.8
1969	4,240.3	169	4.0	514.2	8.9	1.7
1970	4,296.3	169	3.9	558.0	7.6	1.4

Source: IBM—Mineral Statistics of India, January 1971.

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Table 1.1.2: Production of Minerals under Study in Andhra Pradesh and Share of individual Minerals, 1970

Mineral	Production	
	Million Rs.	% Share
Total	7.6	100.0
Manganese	3.5	44.3
Mica	3.4	43.0
Iron ore	0.7	12.7

Source : IBM—Mineral Statistics of India, January 1971.

2. MICA

2.1 Geology & Reserves

2.1.1 Mica belts in Andhra Pradesh are located in the district of Nellore. The Nellore mica belt about 97 kms long and 24-32 kms wide. Majority of the mines are situated along two parallel lines on the eastern and western side of the belt. Most of the pegmatites vary in length from 30 metres to a few hundred metres. The width is generally 15 m bu also reaches upto 60 metres. The Nellore mica is green in colour, generally stained and spotted. Isolated veins of ruby quality mica are found near Tellabodu and Shah mine (Sydapuram area). A pale ruby variety comparable with Bihar ruby mica is found in the mines of Mudigodu. Phlogopite mica occurs in Vishkhapatnam district near Kudia and Majigudem. This is sometimes buckled and cracked and light to deep amber coloured, occuring as irregular clusters and pockets.

2.1.2 It is difficult to estimate accurately the reserves of mica. Attempts have been made by GSI in 1967-68 for locating new pegmatities in covered and uncovered areas and for exploring the existing pegmatites further. However it was found that even though location of a pegmatite could be predicted by the application of geophysical tests, nothing definite could be predicted about the richness and quality of mica in the pegmatite.

2.2 Structure of Mica Mines in Andhra Pradesh

2.2.1 Mica mining in Andhra Pradesh is entirely a venture of the private sector. There is only one mine in West Godavari district and all the remaining (60 mines) are in Nellore district. Proprietorships and partnerships are the two common forms of ownership in the State. Majority of the mineowners in Andhra Pradesh fall under the perview of small scale industries. Except two units in Andhra Pradesh, the total capital investment is less than Rs. 0.75 million.

2.2.2 Mica mining in Andhra Pradesh is by below ground methods. In Andhra Pradesh there were twelve mines with a vertical depth of more than 250 ft. The deepest mine in Andhra Pradesh is about 850 ft. Mechanisation is necessary in Andhra Pradesh as in general the mica bearing pegmatitics occur at a lower depth. Deepseeded mines in Andhra Pradesh make mechanisation a more profitable proposition. Mechanical equipment used include rock drills, compressors, pumps and hoists. The average daily employment in most of the mica mines is less than 100. Among the units surveyed there were only 3 mines employing over 150.

2.3 Production Trend and Grade Structure

2.3.1 There has been a small decrease in the number of operating mines in Andhra Pradesh since 1966. Andhra Pradesh accounted for 12% of the total number of mines and 23% of the total production for ths year 1970. The number of mines closed in Andhra Pradesh is only 10 as against 161 in the entire country duriug the period 1966 to 1970. Most of the closures have been in Bihar and Rajasthan.

2.3.2 Mica production registered a sharp fall from 5,100 tonnes in 1969 to 3,800 tonnes in 1970. The decrease in production is due to the decline in activity in the operating mines and due to the closure of 6 mines during that period. The fall in production has been due to a variety of problems. The primary problem faced by the industry is the rising cost of production and stationary sale prices.

Table 2.3.1 : Number of Mica Mines Operating in India and Andhra Pradesh

Year	All India	Andhra Pradesh
1966	665	71
1967	636	78
1968	634	65
1969	531	67
1970	504	61

Source : Indian Bureau of Mines.

2.3.3 Mica is graded according to size and quality. Green mica along with spots and stains is generally obtained in Nellore district. Ruby mica is also found in certain areas. Grading of mica varies directly with size and inversely with the existence of spots and stains. **Grade**

Table 2.3.3 : Production of Crude Mica, All India and Andhra Pradesh, 1961-70.

(Quantity in thousand tonnes)

Year	Production		
	India	Andhra Pradesh	
	Qty.	Qty.	% Share
1961	28.3	7.0	24.7
1962	28.5	7.0	24.6
1963	25.4	7.1	27.9
1964	22.8	6.1	26.7
1965	23.8	5.6	23.5
1966	22.9	4.4	19.9
1967	18.2	4.1	22.5
1968	18.3	5.1	27.9
1969	17.6	5.1	29.0
1970	16.3	3.8	23.3

Source : IBM—Mineral Statistics of India, January 1971.

Processing

2.3.4 Crude mica obtained from the mines is dressed with a sickle to remove the pegmatite materials adhering to it. Mica thus dressed is processed further using a knife to eliminate defective portions in the block and only the clear portions are retained. The trimmed mica so obtained is processed into mica blocks, films and splittings. Grading is done according to size. There are three fabricating units in Gudur producing punched discs etc. With an increase in demand for fabricated mica in the overseas market a number of exporters are planning to set up fabricating units in the State.

2.4 Cost and Price Stucture

Labour Intensive

2.4.1 Mica mining industry in India is a labour intensive industry. The cost structure of the surveyed units show that in Andhra Pradesh the average labour output ratio is 0.53. The other two major cost components are explosives (0.17) and power and fuel (0.21). The cost coefficients are not constant coefficients and vary rather widely from one mine to the other. This is true of total cost as well as the major cost components (Table 2.4.1).

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Table 2.4.1 : Total Cost of Production and the Cost Components for Selected Mines in Andhra Pradesh during 1969

(Rupees per tonne)

S. No.	Total Cost	Labour	Supervisory Staff	Lubricant	Fuel	Explo-sives	Spares & Stores
1	495.17	242.00	67.40	9.70	55.10	57.50	63.47
2	1,261.22	640.95*	—	48.90	94.47	237.00	239.90
3	1,939.50	595.00	506.00	**	312.00	314.50	212.00
4	1,086.80	335.00	136.10	15.65	167.90	148.00	284.15
5	281.23	152.10*	—	4.94	54.60	50.60	18.99
6	1,141.98	600.67*	—	**	292.67	155.40	93.24
7	1,779.95	622.00	219.00	16.55	582.00	254.50	85.90
8	637.00	209.90	50.70	**	112.50	148.50	117.40
9	983.83	239.00	160.00	0.03	266.10	144.50	174.20
10	656.15	200.50	65.10	9.30	168.00	125.60	87.65
11	975.00	365.50	143.60	18.80	84.80	288.00	74.30

* Include salaries of supervisory staff.

** Included in spares and stores.

Source : ORG Survey of Mica Mines.

Inter - mine Fluctuation in Cost

2.4.2 Analysis of cost data of the units surveyed in Andhra Pradesh shows that the total cost of the surveyed units ranges from Rs. 281.23 to Rs. 1,939.50 per tonne. Inter-mine variations in costs to a large extent is because of the nature of mica mining itself. Unit mining costs of a cross section of big and small mines in Andhra Pradesh at different production levels during 1969 is shown in Table 2.4.2. In addition to inter-mine fluctuating costs, cost for a particular mine vary rather widely over the years. This is not only due to the increase in prices of the major mining equipment and increase in wages but also due to the alternations of rich mica bearing pegmatites and barrens.

Table 2.4.2 : Unit Mining Costs of Selected Mines in Andhra Pradesh and their Production Levels 1969.

S. No.	Production (Tonnes)	Mining Cost (Rs.)
1	558.95	1,939.50
2	69.14	1,141.98
3	260.90	1,086.80
4	265.00	983.83
5	90.49	975.00
6	231.42	666.15
7	255.31	637.00
8	578.81	495.17

Source : ORG Survey of Mica Mines.

2.4.3 The fluctuation in the mining costs for a mine over a period of five years ending 1969 is shown in Table 2.4.3. A detailed analysis of the various cost components, and their effect on the total cost is provided in Chapter VIII of Part II. However, mention must be made here that there has been a steady increase in the prices of the major mining components and the minimum wages which has increased the cost of production quite substantially.

Against the increasing prices of the major components of cost, the industry is faced with stationary floor prices. The floor prices introduced in 1964 has been fixed on the basis of size and quality.

2.5 Marketing and Transportation

2.5.1 Mica industry in India is almost entirely export oriented. Domestic market constitutes a meagre 5% of the total turnover of the industry. Mica produced and processed in the Nellore district of Andhra Pradesh is exported from Madras port. Total value of exports of mica from Madras port in 1969 was Rs. 17 million as against Rs. 20 million in 1968. The decrease is mainly due to a fall in the export of splittings.

Table 2.4.3 : Variations in Total Cost and Cost of Major Components for a Particular Mine in Andhra Pradesh, 1966-69

(Rupees per tonne)

Components of cost	1966	1967	1968	1969
Total	558.30	551.95	448.52	472.77
Labour wages	285.50	237.00	230.50	242.00
Supervisory staff	79.40	75.10	69.90	61.10
Lubricant	6 40	8.05	4.92	9.70
Electricity	64.00	72.10	56.30	55.10
Explosives	56.70	40.80	44.30	57.50
Spare parts	52.10	55.10	41.95	22.00
Store/Drill Rods	14.20	63.80	9.45	19.07

Source : ORG Survey of Mica Mines.

Demand for Fabricated mica

Fabricated mica produced by the three units in Gudur is exported. Contribution of fabricated mica to the total value of exports was only 10% in 1969. There has been an increased demand for fabricated components and the exports are likely to increase. The major importers for fabricated mica are Germany and the United States of America. Problems concerning export of different varieties of mica, their trend etc. are discussed in detail in Chapter VIII of Part II. The problems faced by the exporters in Gudur are the same as those of exporters in Bihar.

Transportation

Partially dressed ore is transported from the mines to the processing units located in Gudur over distances varying from a few kms to 60 kms. Dressed ore is transported in baskets, after initial grading is done at the mine site, by jeeps and cars. Dressed mica for export is transported to the port by road.

As mentioned in Chapter VIII of Part II the long term prospect for the industry lies in the development of fabrication industry. It is expected that the three fabricating units would be in a position to diversify their produce and increase the exports.

3. MANGANESE

Low Grade Ore

3.1 Manganese ore produced in Andhra Pradesh is predominantly of low grade. The ore is high in phosphorus and ferruginous with manganese to iron ratio less than 4:1. The reserves are estimated at 0.51 MT for the entire State.

Very Little Known Reserves

3.2 Manganese ore deposits in Srikakulam district, Andhra Pradesh, occur along four main belts from north-west to south-east. The ore is generally low grade containing, on an average, 36%Mn, 14% Fe, 12% silica and 0.25% phosphorus. The ore from Kodur-Garbham, Aitemvalasa area is generally low in phosphorus and high in iron.

Very small share in the Country's Manganese Industry

3.3 Manganese ore production from Andhra Pradesh contributes less than 10% to the total quantity of ore produced in the country. In terms of value the contribution is less than 5%. Manganese ore production in the State has remained rather steady around 150 thousand tonnes since 1964. Almost the whole of this production (98%) is of low grade (below 38% Mn).

Export Oriented

3.4 There is very little domestic consumption of low grade manganese ore. Most of the manganese ore produced in Andhra Pradesh is exported through Vishakapatnam port which is located at a distance of the 80 kms from the Garividi and Gujjangivalasa loading points respectively. None of the manganese ore mines in the State was covered during the mineral survey.

4. IRON ORE AND BASE METALS

Iron Ore

4.1 Iron ore reserves in the State are estimated at 18MT. Deposits of iron ore, occur in more than half of the 20 districts of Andhra Pradesh. The State's contribution to the total iron ore production in the country is insignificant (0.3%). There has been a steady decrease in the activity and a number of mines have closed down. There were only 10 mines in 1970 as against 55 mines in 1964. The declining trend is because of the preference being given to the high grade ore from the Ballary-Hospet area in Mysore and due to the problem of transporting ore from mine to the port. Ore fetches a low price because of the long transportation lead and the necessity of providing transhipment facility at Guntakal for the ore to be exported from Madras port.

Copper

4.2 Andhra Pradesh, with a proven copper reserves of 12.2 MT of 1.1% Cu, accounts for 3.3 of% India's total reserves and ranks fourth in the State-wise classification. The more important Cu deposits are located in the Agnigundala and Mailaram belts and the largest of these is in Nallakonda, where 3.2 MT of ore of 1.82% Cu content have been proved. A mine is to be developed in the Agnigundala belt by Hindustan Copper Limited.

Lead - Zinc

4.3 Andhra Pradesh ranks next to Rajasthan and accounts for 11.3% of the total lead-zinc deposits in the country. The Bandalamotta deposit in the Agnigundala belt with an estimated reserve of 10 MT of 6.5% Pb, and 1.4 MT of 3.1% Pb, is the most important lead deposit in India. The Dhukonda deposit has an estimated reserve of 0.46 MT of 8.98% pb. Work is yet to start on the development of these deposits.

CHAPTER II—BIHAR

1. INTRODUCTION

1.1.1 In India's mineral economy Bihar plays a strategic role. She is the highest contributor (31%) to the country's total value of minerals produced. With regard to production of certain minerals like kyanite, pyrite and copper, about 90% of the total production comes from this State. **Highest Contribution**

1.1.2 Over the past five years Bihar's contribution to the country's total value of minerals produced varied from 30 to 32%, although in terms of absolute value, there has been an annual growth rate of 8% (Table 1.1.1). This is slightly lower than the annual growth rate observed in the country during the five year period. This is also true for the minerals under study.

Table 1.1.1 : Share of Bihar in the Mineral Production of India—Major Minerals and Minerals Under Study

(In million Rs.)

Year	Major Minerals			Minerals Under Study		
	India	Bihar	%	India	Bihar	%
1966	2,917.1	943.9	32.3	419.1	131.4	31.3
1967	3,317.9	1,005.8	30.3	449.0	137.4	30.6
1968	3,810.4	1,204.0	31.6	499.8	154.9	31.0
1969	4,240.3	1,356.7	32.0	514.2	159.0	30.9
1970	4,296.3	1.332.6	31.0	558.0	162.3	29.1

Source : IBM—Mineral Statistics of India, January 1971.

1.1.3 Out of the minerals under study, Bihar has been endowed with all minerals except lead and zinc. But the contribution of these minerals varies widely. Iron ore, with 47% of the total production, tops the list followed by copper (23.1%) and kyanite (13.4%). Although Bihar is a major producer of mica and the sole producer of pyrites, contributions of these two minerals to the value of minerals under study are 7.1% and 4.3% respectively (Table 1.1.2). **Rich in Many Minerals**

1.1.4 Mining in Bihar is as old as mining in Orissa since these two States were previously one. The district of Singhbhum is the centre of mining activities in the State. Except mica and bauxite, most of the mines of the other minerals are located in this district.

1.1.5 In the present analysis we have confined our discussion to three minerals viz., iron ore, mica and bauxite. As regards copper, kyanite and pyrites, it may be mentioned that Bihar's contribution to the country's production varies from nearly 90% to cent percent. Since these minerals are studied in great depth in Part II their analysis have been excluded from this Chapter.

Chromite and manganese, being insignificant both from the State point of view as well as from the country point of view, have also been separated from the present analysis.

Table 1.1.2 : **Production of Minerals Uuder Study in Bihar and Shares of Individual Minerals (1970)**

Mineral	Value (Million Rs.)	% Share
Iron ore	77.4	47.7
Copper	37.5	23.1
Kyanite	21.8	13.4
Mica	11.5	7.1
Pyrites	7.8	4.8
Bauxite	5.8	3.6
Manganese	0.4	0.3
Chromite	0.1	—

Source : IBM—Mineral Statistics of India, January 1971.

2. IRON ORE

2.1 Geology and Reserves

2.1.1 Iron ore reserves in Bihar have been estimated to be 1680 MT. Most of her reserves are found in Singhbhum district. In this State the ore occurs in the banded hematite jaspers. Magnetite deposits are insignificant. Deposits which are worth mentioning include Kiriburu (413 MT), Noamundi (295 MT), Manoharpur (284 MT) and Gua (170 MT). The ores are generally massive, hard, compact and dark brown to brownish black with iron content varying from 58% to 70%. Alumina is invariably more than silica and the average phosphorus content is very low.

2.2 Structure of Iron Ore Mines

Concentration in Singhbhum

2.2.1 Next to mica, iron ore accounts for the largest number of mines pertaining to the minerals under study. Out of 23 mines operating in this State in 1970, 22 mines were located in the district of Singhbhum. The only other district, where a single mine was reported to be working, was Palamau. But this is a very small mine, the annual production being less than five thousand tonnes.

2.2.2 The four impoitant mines of Bihar which contribute the bulk of iron ore production are Noamundi, Gua, Manoharpur and Kiriburu. While the first three belong to the private sector, the mine at Kiriburu is operated by the

National Mineral Development Corporation, a Government of India undertaking. Three of these mines are fully mechanised. Noamundi is the biggest captive mine of Tata Iron and Steel Company whereas Manoharpur and Gua are the captive mines of Indian Iron and Steel Co. Kiriburu, which is at present despatching all its produce for export, is the prospective captive mine of Bokaro Steel Plant and has an ambitious expansion plan of raising its present production capacity of 2 MT to 4.5 MT per year.

2.3 Production and Grade Structure

2.3.1 There has been a significant reduction in the number of mines working in this State. As against 40 mines in 1966, the total number of iron ore mines operating was 23 in 1970 (Table 2.3.1). The two main reasons that can be attributed for this decline are lack of finance and uncertainty in the market.

Number of Mines Decline

Table 2.3.1 : Number of Iron Ore Mines Operating in Bihar.

Year	Number of Mines
1966	40
1967	34
1968	34
1969	34
1970	23

Source : (1) DGMS—Statistics of Mines in India, Vol II, Non-Coal.
(2) IBM—Mineral Statistics of India, January 1971.

2.3.2 Bihar, which had been occupying a third place in the country's total iron ore production till recently, lost its position to Madhya Pradesh in the year 1969. Presently her contribution to the total production is 16.6% as against 23.3% in the case of Madhya Pradesh. It may be seen from Table 2.3.2 that up to 1968 iron ore production in Bihar had an uninterrupted growth. Production in that year was the highest during 1960-70. But since then there has been gradual decrease in the production.

Declining Trend in Production

2.3.4 Ore produced in Bihar is of generally high grade. Ratio of fines to lump is high in mechanised mines. In the mine at Noamundi about 50% of ore produced are fines and blue dust. For this reason a pelletisation plant has been set up there to produce 1 MT of pellets per year.

High Grade

2.4 Processing of Iron Ore

2.4.1 Processing of ore in this State is confined to beneficiation by ore dressing techniques and agglomeration. The first sintering plant of the country was established in this State at Jamshedpur in 1959 by the Tata Iron and Steel

Table 2.3.2 : **Production of Iron Ore—All India and Share of Bihar**

Year	All India	Bihar	
	Qty. (MT)	Qty. (MT)	%
1960	16.5	2.8	17.2
1961	17.8	2.0	11.5
1962	19.1	3.0	15.8
1963	21.1	3.5	16.4
1964	21.9	3.7	16.7
1965	23.9	4.3	17.9
1966	26.7	5.4	20.2
1967	25.9	5.4	20.8
1968	28.0	5.7	20.5
1969	29.2	5.3	18.3
1970	30.8	5.1	16.6

Source : IBM—Mineral Statistics of India, January 1971.

Company. The same company has also installed a pelletisation plant, being the second of its kind in India, at Noamundi. This plant, with the highest capacity (1 MT per year) in the country, will go into production soon. Setting up of a beneficiation plant at Kiriburu is under study.

2.5 Cost and Price Structure

No Significant Variation

2.5.1 Mining cost of iron ore mines in Bihar does not vary significantly from that in mines in Orissa. This is because most of the mines in these two States exist in a particular zone. In fact a part of the mining area in many cases has fallen in Orissa. To take an example, parts of the mines at Kiriburu and Noamundi fall under the administrative territory of Orissa. Cost of mining generally varies from Rs. 3/- to Rs. 4/- per tonne.

2.6 Marketing and Transportation

Outlet Inadequate

2.6.1 Three of the major mines of the State, viz. Noamundi, Gua and Manoharpur, are captive mines of two steel plants and hence their entire production is despatched to the corresponding steel mills. As regards production of the mine at Kiriburu, it is transported to Vishakhapatnam for export to Japan. Thus there appears to be no marketing problem so far as the big mines are concerned. But in tbe case of other mines, absence of an adequate outlet has created a serious problem.

2.7 Future Prospects

2.7.1 The future production of iron ore is likely to be influenced much by a few big mines. The mine at Kiriburu has an expansion plan which will raise its production by 2.5 MT. The pelletisation plant, when put into operation, will add 1 MT of pellets to the State's production. A few of the big mineowners plan to raise their production if they get a market for their produce abroad. What will happen to the majority of small mineowners? The answer lies in to what extent they get an outlet for the ores that have been piling up at present.

3. MICA

3.1 Geology and Reserves

3.1.1 High quality block mica is obtained from the Bihar mica belt in an area extending from Gaya and Palamau districts on the west for 145 kms through Hazaribagh and Monghyr districts to Bhagalpur district on the east; the width of the belt ranges between 26 and 32 km. The more important part of this belt is along the dissected northern edge of the Chotanagpur plateau. The mica content varies between 20 and 36%. The Kodarma Reserve Forest in Hazaribagh district is an important mica mining centre, the other centres being Chatkari, Dharkakola, Domchanch, Gawan, Tisri, Mahesari, Chakal etc. Mica in Bihar is chiefly of ruby colour, but green, white, silvery and brown micas are also found in limited quantities. The mica occurs as books varying usually from 15 to 20 cm across but may be up to 90 cm or more. The average thickness of the books is 7.5 cm to 10 cm but may vary up to 60 cms or more. The mica zone in any vein as a rule does not exceed 90 cm in thickness.

3.1.2 Besides Hazaribagh district, muscovite mica is also worked in Gaya and Monghyr districts while lepidolite occurrences, disseminated books and smaller segregated pockets in pegmatite near Bajaiya are reported. However, there are also reported occurrences of mica in the pegmatites of Dhanbad, Palamau, Ranchi and Singhbhum districts which are all of minor importance.

3.2 Structure of Mica Mining Industry in Bihar

3.2.1 Mica mining in India is almost entirely a private sector venture. Bihar is no exception to this. Safi mica mines are the only public sector mines, run by the Department of Mines and Geology, Government of Bihar. Total number of mines operated were four and total production was about 67 tonnes during 1969. This constituted only about 0.8% of total production in Bihar during the same year. Proprietorships and partnerships are the two common forms of ownership in the private sector in Bihar. Proprietorship is more common. The third group of mineowners are private limited companies.

Private Sector Venture

3.2.2 Majority of the mica mineowners in India fall in the class of owners of small scale industries. Small mineowners are less common in Bihar. In Bihar

Capital Investment

there are 13 mineowners with capital investment of more than Rs 7.5 lakhs. These units together accounted for about 81% of total crude production during 1969.

Production and Employment

3.2.3 Measured in terms of average daily employment, production and by size of total capital investment, mica mining in India consists of a large number of small operators/units. Bihar is no exception to this, although of all the mica producing States it has got the largest number of big mines. The same is also true of average daily employment in the mines. Majority of the big mines with high average daily employment are located in Bihar.

Mechanisation

3.2.4 Mechanisation, in general, is more common in Andhra Pradesh and Bihar than in Rajasthan. Deep-seeded mines in Bihar seem to make mechanisation a more profitable proposition. But, mechanisation is confined only to a few underground mines and there are a few opencast mines which are semi-mechanised.

3.3 Production Trend and Grade Structure

Declining Activity

3.3.1 Mica mining in Bihar is undergoing a long spell of declining activities. In fact it is the declining production in Bihar which has been mostly responsible for decline in the all India production. Number of working mines in Bihar declined from 432 in 1961 to 262 in 1970. Total production declined by about 5,000 tonnes—from 13,600 tonnes in 1961 to 8,900 tonnes in 1970. Percentage decline was about 36. Number of working mines, production and share of Bihar in all India production during 1961-70 are shown below (Table 3.3.1).

Table 3.3.1 : Number of Working Mines and Production of Mica in Bihar, 1961-70

Year	No. of working mines	Production (In thousand tonnes)	% of all India production
1961	432	13.6	48.0
1962	434	14.0	49.0
1963	413	11.4	44.9
1964	371	11.2	49.1
1965	373	11.7	49.1
1966	378	12.7	55.4
1967	350	10.0	54.9
1968	353	9.2	50.2
1969	267	8.4	47.7
1970	262	8.9	54.6

Source : Indian Bureau of Mines.

The reason generally put forward by the mineowners for declining activities is the decline in the profitability of the mining operations resulting from increasing costs of production against stationary floor prices for exports.

3.3.3 Of the total production of crude mica from the mines, about 70% is rejected as waste and scrap. Only about 30% is recovered as usable blocks, films and splittings. The recovery in Bihar is higher than in other producing States, because the major part of Bihar's crude mica production is of high quality. Most of the high grade condenser films and blocks are made from Bihar ruby mica.

Grade of Bihar Mica

3.4 Processing of Mica

3.4.1 Crude mica obtained from the mines is mixed with pegmatite materials and hence it is sent to cutting sheds for dressing. The preliminary dressing (cobbing) of crude mica is done at mine sites and trimming shops. Crude 'blocks' are freed from dirt and waste as well as defective materials such as ruled, buckled, wrinkled, and wavy mica and only sound mica is retained. Trimmed mica, also known as sheet mica, is finally processed into mica blocks, films and splittings with sickle or knife. Dressing and final processing is done at Kodarma, Giridih and Hazaribagh in Bihar. The trimmed mica from Rajasthan also is sent to these centres for final processing.

3.5 Cost and Price Structure

3.5.1 Mica mining in Bihar, as in India, is a labour intensive industry. The cost structure of the surveyed mines shows that average labour-output ratio (labour includes supervisory staff also) in Bihar is 0.62. The other two major cost components are explosives and power and fuel. Estimated cost-coefficients of mica mining in Bihar are shown below :

Cost Coefficients in Mica Mining

Total Cost	Labour	Power & fuel	Explosives	Lubricants	Spares & Stores
1.00	0.62	0.14	0.11	0.01	0.12

3.5.2 The above coefficients are not constant coefficients. They vary rather widely, from one mine to another. Variations in the cost coefficients also indicate the variations in actual costs. Inter-mine fluctuations in costs are very wide. This is true of total as well as the major cost components. Inter-mine variations in costs, to a large extent, are inherent in the nature of mica mining itself. The highly erratic character of natural occurrence of mica makes it virtually impossible to predict the richness of deposits in a particular vein. And, the costs involved are independent of whether the particular pegmatites are rich or completely barren. Also, when in one case, pegmatites are continuously rich and in another they continue to be barren, difference in unit costs will be very high. Unit mining costs of a cross-section of big and small mines in Bihar of different production levels during 1969 are shown in Table 3.5.1.

Wide Variations in Unit Cost

Table 3.5.1 : Unit Mining Costs of Selected Mines in Bihar and their Production Levels, 1969

S. No.	Production (tonnes)	Mining Cost (Rs./tonne)
1	87.00	1,210.00
2	95.00	1,050.00
3	128.00	973.00
4	203.00	598.00
5	232.00	909.00
6	274.50	281.23
7	296.30	163.83
8	320.00	1,035.00

Source : ORG Survey of Mica Mines.

No Fixed Trend in Unit Cost

3.5.3 Alternations of rich deposits and poor deposits or barrens not only explain inter-mine fluctuations of cost in a particular year, but also fluctuations in cost of a particular mine over the years. Cost structure of selected mines has been studied over the ten years. But, in each of the mines neither total unit cost nor the individual components show any steady trend, in spite of the fact that there had been definite increase in costs of major mining equipment and accessories, such as rock drills, compressors, drill steel, candles and electricity. Fluctuations in unit mining costs of selected mines during 1965-69 in Bihar are shown in Table 3.5.2.

Table 3.5.2 : Fluctuations in Unit Mining Cost of Mica, 1965-69

S. No.	Cost (Rs./Tonne)				
	1965	1966	1967	1968	1969
1	624.00	747.00	358.00	799.00	1,210.00
2	746.00	759.00	939.00	535.00	1,050.00
3	1,574.00	1,421.00	1,311.00	2,034.00	973.00
4	425.00	559.00	514.00	998.00	598.00
5	568.00	477.00	735.00	1,290.00	909.00
6	NA	558.30	551.95	448.52	472.77
7	NA	115.49	111.36	117.53	163.83
8	607.00	529.00	805.00	747.00	1,035.00

Source : ORG Survey of Mica Mines.

3.5.4 Against increasing prices of major components of cost, the industry is faced with stationary floor prices since 1964. The floor prices of major marketable sizes and qualities of blocks, films and splittings have been fixed by the Government (Refer Chapter VIII of Part II).

Mica Floor Prices

3.6 Marketing

3.6.1 Mica industry in India is almost entirely export oriented. Domestic sales constitute only about 5% of the total turnover of the industry. Exports of Bihar constitute about 85% of all India exports of mica and mica products. Mica exported from Bihar, as from India, is predominantly natural mica. The major items of natural mica exported are blocks (52%), splittings (38%) and films (10%).

Mica Exports of Bihar

3.6.2 The export of splittings declined by more than 40% over the ten year period, from Rs. 91.2 million in 1960-61 to Rs. 54.4 million in 1969-70. Both book form and loose splittings declined almost in equal proportions. India has practically lost the splittings market in the USSR and West Germany. Exports to the UK have declined by about 70%. The obvious reason for decline in export of splittings from India is the fall of world demand because of the growth of the reconstituted mica paper industry in the consuming countries.

Export of Splittings Steadily Declining

3.6.3 Besides natural mica, India (mostly from Bihar) also exports various fabricated parts. More than 50% of fabricated mica exports is to the USA. Value added by fabrication is high compared to many manufacturing industries. In view of the fact that value added by fabrication is high (normally not less than 50%), one of the most important ways to increase foreign exchange earnings from mica would be to promote exports of fabricated parts. There is good world demand and that India has good prospects in this is partly substantiated by steady increase in export of fabricated parts, from about Rs. 1.1 million in 1960-61 to Rs. 21.7 million in 1969-70.

Export of Fabricated Mica

4. BAUXITE

4.1.1 Bauxite reserves in Bihar are in the order of 18.4 MT and this constitutes 11.8% of the country's total bauxite reserves. Occurrences of this mineral are noticed in Ranchi district and to a lesser extent in the districts of Monghyr, Palamau and Shahabad. The alumina content varies from 49% to 60%. The district of Ranchi accounts for the largest reserves in the State. In terms of quality also ore in this district is of high grade.

Reserves

4.2 Structure of Bauxite Mines

4.2.1. The State of Bihar has only 10 bauxite mines. But it is the third State in the country, ordered according to number of bauxite mines. Most of the mines are in the private sector. The four largest mines account for about 87% of the total production in 1970. These four mines are captive mines of Hindustan

Major Operators

Aluminium Co. Ltd. (3 mines) and Indian Aluminium Co. Ltd. (1 mine). The mines of the former are situated in Birhnipat, Maidanpat and Manduapat. The mine at Bagru Hill belongs to the latter.

Type of Working

4.2.2 The capacity of the above 4 mines to produce about 87% of the total production of Bihar, itself indicates that there is a great difference in the type of working of the mines in the State. Bagru Hill and Manduapat mines are fully mechanised, whereas the rest eight are either semi-mechanised or non-mechanised.

4.3 Production and Grade Structure

4.3.1 There has not been any significant change in the number of mines in the State since 1966 (Table 4.3.1). There were 9 mines in 1966 and 1968. During the other three years the number remained at 10.

Table 4.3.1 : Number of Bauxite Mines Operating in Bihar

Year	Number
1966	9
1967	10
1968	9
1969	10
1970	10

Source : DGMS—Statistics of Mines in India, Non—Coal, 1966, 1967 and 1968.
IBM—Mineral Statistics of India, January 1971.

Production Trend

4.3.2 Bihar produces maximum bauxite ore in the country although it has only 16% of mines. This is because of the fact that the above four captive mines have to produce ore enough to feed their associated aluminium plants. An analysis of the production data over the past ten years shows that as against 106.3 thousand tonnes in 1960, bauxite production has had a rising trend (except in 1965 and 1969) to reach its present production level of 493 thousand tonnes (Table 4.3.2). The grade of ore varies from 49% to 60%.

4.4 Processing of Bauxite

4.4.1 The bauxite mined at present is of high grade quality suitable for the aluminium industry. Hence the problem of processing has not yet been felt. However, to feed the existing plants as well as plants that may come up in future for a considerable period of time, beneficiation of low-grade bauxite will have to be considered in the near future.

Table 4.3.2 : Production of Bauxite—All India and Share of Bihar

(Quantity in thousand tonnes)

Year	All India	Bihar	
	Qty.	Qty.	%
1961	475.9	153.7	32.3
1962	586.8	218.1	37.2
1963	566.7	275.0	48.5
1964	593.5	337.6	56.9
1965	706.6	322.3	45.6
1966	749.9	379.7	50.6
1967	804.1	403.7	50.2
1968	957.6	463.6	48.4
1969	1,063.1	457.5	42.5
1970	1,434.6	493.1	34.8

Source : IBM—Mineral Statistics of India, January 1971.

4.5. Cost and Price Structure

4.5.1 Mining cost of the selected mines does not vary much. Data available in respect of four mines show that during 1970, the maximum difference has been only twenty six paise (Table 4.5.1).

Table 4.5.1 : Mining Cost of Selected Mines in Bihar

S. No.	Cost (Rs. per tonne)	
	1969	1970
1	7.28	6.66
2	7.28	6.66
3	6.30	6.40
4	6.75	6.60

Source : ORG Mineral Survey.

4.5.2 Although mining cost does not vary much from mine to mine, a large variation is seen in f. o. r. cost. The mechanised mines with ropeways and being nearer to railway sidings have lower f. o. r. cost than those not having such facilities.

4.6 Marketing

4.6.1 The bulk of the production from Bihar is consumed by the alumina/aluminium plants at Muri in Bihar, Asansol in West Bengal and Renukoot in Uttar Pradesh. **Internal Consumption**

CHAPTER III—GOA

1. INTRODUCION

1.1.1 Goa ranks tenth among the mineral producing States in India, with a contribution of 2.5% to the total major mineral production in the country. Goa's contribution to the mineral extraction registered a small increase during the three years ending 1970 (1.7% in 1968 to 2.5% in 1970). This increase in the relative share is due to increased iron ore production in Goa. Goa contributes 19% by value to the total production of the minerals under study. It would be noticed from Table 1.1 that the share of Goa increased very sharply, from 10.2% to 19.0%, during 1968-70 in the all India production of minerals under study. This is due to the increase in iron ore production in the State from Rs. 51 million to Rs. 101 million during the same period.

Iron Ore the most Important Mineral

1.1.2 Iron ore is the most important mineral of Goa. This constitutes about 95% of the total value of the mineral production of the State. The other two minerals are manganese ore (3.7%). and bauxite (0 9%). Bauxite mining is a very recent development with mining starting in 1968. Manganese ore mined in Goa is mostly low grade ferruginous ore more commonly known in Goa as ferro manganese. Relative shares of different minerals in the total mineral production of Goa are shown in Table 1.2.

Table 1.1.1 : Share of Goa in the Mineral Production of India—Major Minerals and Minerals Under Study

(In million rupees)

Year	All Minerals			Minerals Under Study		
	India	Goa	% Share	India	Goa	% Share
1966	2,917.6	67.5	2.3	419.1	67.5	16.7
1967	3,317.7	67.9	2.0	449.0	67.9	15.1
1968	3,810.4	71.0	1.8	499.8	71.0	14.2
1969	4,240.3	86.3	2.0	514.2	86.3	16.8
1970	4,296.3	106.4	2.5	558.0	106.4	19.0

Source : IBM—Mineral Statistics of India, January 1971.

Table 1.1.2 : Production of Minerals Under Study in Goa and Shares of Individual Minerals, 1970

Mineral	Production	
	Million Rs.	% Share
Total	106.4	100.0
Iron ore	101.4	95.4
Manganese	4.0	3.7
Bauxite	1.0	0.9

Source : IBM—Mineral Statistics of India, January 1971.

2. IRON ORE

2.1 Geology and Reserves

2.1.1 Goa with a reserve of 500 MT ranks fifth among the States with known iron ore reserves and contributes 5.1% to the total estimated reserves in the country. Iron ore is found in the taluks of Pali, Bicholim, Sanguem and Satari. The ore is generally laminated, porous and friable. Two other varieties of ore are also found and produced, viz. manganiferous iron ore or black iron ore with manganese content up to 15% and a total metal content of 50% and ferruginous manganese ore, popularly known as ferro manganese, with a minimum of 28% manganese and a total metal content of 50%.

2.2 Structure of Iron Ore Mines in Goa

2.2.1 Concessions for exploiting the minerals in the territory were issued during the Portugese regime. These concessions were granted to the interested parties on their request. A total of 786 concessions were granted during the regime, with areas varying from 8 hectares to 100 hectares. Most of these concessions have been converted into mining leases with effect from January 15, 1966 and are now under the purview of different mining laws, rules and regulations applicable to other mining areas in the country. Prospecting of lease areas has indicated that less than 50% of the area is mineral bearing. Further development has not been done in the non-mineral bearing leases after initial prospecting.

Nature of Ownership

2.2.2 Mining in Goa is with the private sector. Most of the big operators are exporters as the main outlet of their produce is through exports. Six operators working about 18 mines produce 60% of the total production in Goa. These operators have crushing and screening plants with capacities of 200-250 tonnes per hr. at their mines. The bigger units are private limited companies and the smaller units are proprietory. Some of the important mines are Pale, Sonshi, Sirigao, Orassodongor and Sanguelim.

Type of Working

2.2.3 Iron ore is found on the hill slopes and occurs in the northern part of the territory in three contiguous ranges rising to a height of 150 metres. Iron ore mining in Goa is characterised by a large number of small leases worked manually and having an annual production of 10,000 tonnes or less, and a small number of large, highly mechanised mines. Investment in mines ranges from a few thousands to a few crores depending upon the size of the mine, scale of operation and mechanisation. All iron ore mines in Goa are opencast with working depths varying from a few metres to 50 metres. Most of the mines work on a single shift with normal working hours of 8 a.m. to 12 noon and 2 p.m. to 6 p.m. There is a seasonal scaling down of operations in mechanised mines for 2½ to 4 months (July to September) each year during the monsoon. Mine development, involving stripping of overburden etc., is done during this lean period. Some of the semi-mechanised and non-mechanised mines limit their operations to the bare minimum during this period.

2.2.4 Mechanisation of iron ore mines is limited to large lease areas with adequate proven deposits. In addition, the extent of mechanisation depends upon the market for the produce and is usually based on the contracts the mineowners have with their foreign buyers. The contracts are generally for a five year period. Mechanisation is not possible in small areas having deposits which occur irregularly and are discontinuous. Mechanical equipment like rippers, dozers, dumpers, etc., are used for stripping and excavation work. Blue dust or the powdery ore occurring just below a massive overburden is mined with the aid of rippers, dozers, etc. However, mining of lumpy ore is manual in most of the mines. There are six fully mechanised mines in Goa using equipment for stripping, excavation and transportation of ore. There are about thirty semi-mechanised mines and all the others are worked manually. The average daily production of the mechanised mines is 1.4 tonnes/man day as against 3.0 and 2.25 tonnes/man day of semi and non-mechanised mines respectively. The average production of the mechanised mine is high because of the effective performance of the mechanical equipment in stripping of overburden and extraction of the ore and the developmental work being done during the monsoon when there is an overall scaling down of other operations.

Mechanisation

2.2.5 Most of the mines in Goa have an average daily employment of 100 and below. The Pale mine employed 735 workers in 1969-70 and the Chowgule's are the largest single employers, employing about 1,600. Sesa & Min Goa, and Salgaocar are the other two mineowners employing more than 500 personnel in their mining operations. Contract labour is still in vogue. Operators face a labour shortage during the sowing and harvest seasons.

Employment

2.2.6 Accidents in iron ore mines are few. Reports from the Director-General of Mines Safety show a frequency rate of 2.3 accidents per thousand employed with fatal injuries during 1968. Improper benching and undercutting of overburden are the main reasons for these accidents.

Safety

2.3 Production Trend and Grade Structure

2.3.1 The Goan iron ore averages 58-60% Fe with a 2 to 1 ratio of powdery and blue dust to lumpy ore. The alumina content varies from 5 to 10%. Ore intended for exports has been classified for both lumpy ore and fines as high (above 65%), medium (62-64%) and low (58-62%). Lumpy ore above 62% contributed only 1.5% to the total production in 1970. The Sancordem sector of Goa produces ore which has 60% Fe.

2.3.2 Goa is the largest contributor to the iron ore production in India. Goa's share in India's production has decreased to 28.5% in 1970 as against 35.9% in 1960. Goa's contribution to the total production in the country has registered a decrease because of the increased production in Madhya Pradesh (1.4 MT in 1960 to 7.2 MT in 1970).

2.3.3 Production of iron ore in Goa shows an increasing trend over the past ten years except during 1961 and 1962 when there was a fall. However, since 1963 there has been a sharp increase, 8.8 MT in 1970 as against 5.5 MT in 1963, an increase of 60% in production. This has been possible because of mechanisation and development of the mines and an outlet for the low grade ore and fines.

Decrease in Number of Operating Mines

2.3.4 There are 80 working mines in Goa in 1969 as against a total of 312 mines in India. There has been a steady decrease in the number of operating mines ; as against 111 working mines in 1965 there were only 80 in 1969 (Table 2.3.2). Even though the produce and export from Goa is predominantly low grade, the small mineowners find it difficult to market their produce because of an existing surplus of low grade ore with the bigger operators who are also exporters. In addition mining of ore in small lease areas is quite uneconomical because of the unsuitability of mechanisation in these areas and high operating costs. Most of the mines that have been closed down in the past have lease areas that do not justify any form of mechanisation and have 56-57% Fe ore which is not marketable under the prevailing conditions unless beneficiated.

Table 2.3.1 : Production of Iron Ore during 1961-70 All India and Goa

(Quantity in million tonnes)

	All India	Goa	
Year	Qty.	Qty.	% Share
1961	17.8	6.4	36.0
1962	19.1	6.1	32.2
1963	21.1	5.5	26.1
1964	21.9	6.1	27.6
1965	23.9	6.7	28.0
1966	26.7	6.7	25.0
1967	25.9	6.8	26.0
1968	28.0	6.9	24.5
1969	29.2	7.7	26.2
1970	30.8	8.8	28.5

Source : IBM—Mineral Statistics of India, January 1971.

Table 2.3.2 : Number of Iron Ore Mines Operated during 1966-70, All India and Goa

Year	All India	Goa
1966	299	91
1967	273	91
1968	257	85
1969	312	80
1970	299	80

Source : 1. DGMS—Statistics of Mines in India, Non—Coal, Vol. II, 1966, 1967 and 1968.
2. IBM—Mineral Statistics of India 1969 and 1970.

2.4 Beneficiation

Need for Beneficiation

2.4.1 Mineowners in Goa are aware of the fact that low grade ore can be beneficiated and exported at better rates. The Goan ore being predominantly low grade will need beneficiation if the present export trend is to be sustained. As the demand is only for 58% Fe and above, the mineowner in order to get the required quantity has to reject about 40 to 60% of the extraction. It is estimated that the first rejects (45—50% Fe) would be to the tune of 70—80 MT in the last decade and is likely to be a much higher figure if (45—50% Fe) ore which is being thrown away with the overburden is also taken into account.

2.4.2 Four of the six mechanised mines have crushing and screening plants (300—500 tonnes/hr, mesh size—10 mm to + 10 mm). Improvement of grade is about 2 to 3%. One of the units have a hydrocyclone-flotation method for improving the grade resulting in an improvement of 4 to 5%. However, the method is not very effective because of the high alumina content. The float containing 50% Fe and less is stored for future use. The disposal of slime is a problem. 350 thousand litres/hr of water is being used for a feed of 250 tonnes per hr of the crushed ore. Large settling tanks are being used now for the disposal of slime. A better method of slime disposal is under study and development. The four plants together have a capacity of 8,500 tonnes of run-of-mine ore per day and average improvement in grade is 3 to 4% with a recovery of 60—70%. A pelletisation plant (first of its kind in the country) was installed in 1967 with German collaboration and has a capacity of 1970 tonnes/day on 24 hour working. The whole plant from planning to commissioning was completed in 18 months. The unit produced about 500 thousand tonnes of pellets during 1970 and has reported no major breakdowns or shutdowns. Problems of fluctuating voltage and high alumina content have affected the production to a certain extent. The fob realisation of pellets is about three times that of fines.

2.5 Cost and Price Structure

2.5.1 The average cost of production including the transportation to the jetty varies between Rs. 14 and Rs. 18/tonne. Break up of the cost and the average cost for the previous years were not made available. However, it has been reported that the operators in Goa are facing a difficult situation mainly due to the increase in the cost structure of the mineral ore and the steadily declining fobt prices of all the ores. Furthermore, the Japanese, the largest single buyers of Goan ore, prefer fines to lumpy ore. The prices of fines are on the lower side and the greater demand has decreased the prices of other grades.

2.5.2 Comparison of the 1962 fobt prices with those of 1970 for all grades of ore indicates a fall particularly for fines. Fobt prices have decreased for 60% Fe fines from \$ 5.00/ton in 1967 to \$ 3.91 and for 62% Fe fines from \$ 5.30 to \$ 4.20. Prices of lumpy ore have also decreased by 10 to 20% in different grades. Mechanisation of the mines has been found to reduce the imbalance between the cost of production and fobt prices. Increased loading rates from 3,000 to 3,500 tonnes/day for lumpy ore and 3,500 to 4,000 TPD for fines have countered the rising ocean freights. However, the problem of high cost of production is still the largest stumbling block for increased production and exports.

High cost & low FOBT prices

2.5.3 Most of the mechanised mines in Goa have imported machinery. High cost of spares since devaluation and non-availability has increased the cost of production. The export incentive under which 10% of the export earnings could be utilised for the import of mining machinery was withdrawn and export duty was clamped down after devaluation. Besides, the 10% tax benefit on exported fines was cancelled. Mention must also be made here of the increase in costs of the other mining components which are indispensable to the mining industry like fuel (petrol & diesel) tyres and tubes, barges, machinery and spares whose prevailing prices have forced the mineowners to severely restrict their operations.

Withdrawl of Incentives for Exports

2.6 Transportation

2.6.1 Goa is blessed with a network of navigable rivers which has made transportation quite economical. The Mandovi and Zuari rivers pass through the iron ore and manganese bearing areas and join the sea near Marmagao harbour. This has facilitated cheap transport of ore by barges from the mines to the harbour. In general, transport of the ore from the mines to the jetties is done by road in rear dumpers over distances ranging from 5 to 50 kms. In one case a rope way 3.8 kms long is in use. It transports about 1 MT of iron ore every year. The average length of haul from the jetties to the port is about 62 kms.

2.6.2 At the jetties the big operators have their own wharves equipped with conveyor belts or improvised dumping platforms from which a rear dumper

could discharge ore directly on to the barge. A few have installed screening plants also, so that the ore is screened before loading into barges. The barges carrying ore have a capacity varying from 150 tonnes to 1,000 tonnes. These barges carry the ore to the Marmagao port where the ore is either stockpiled or loaded directly on the ships, at berth or midstream. Marmagao port is an all weather port and is situated at the mouth of the Zuari river. One of the berths at this port is equiped with a mechanised ore handling plant with loading capacity of 1,000 tonnes per hour. Three-fourths of the total ore traffic of the port is handled in midstream. The average loading rate is about 8,000 tonnes per day in midstream and over 7,500 tonnes per day at the mechanised berth. The average turn-around time of a barge is about 24 hours. A private firm has reported a turn-around time of 18 hours and an average midstream loading rate of 10,000—11,000 tonnes per day. One private company is using a 15,000 tonne capacity vessel for off-shore loading of ore into a bigger ship (50,000 to 60,000 tonnes). after the latter has been loaded upto 15,000 tonnes at the mechanised berth and taken into midstream for loading to its full capacity. The time taken for this operation varies from three to five days depending upon the weather conditions.

2.6.3 *Problems in Transportation.* Transport of ore from the mines to the jetties is by dumpers and lorries which ply over very poor roads. These roads were laid and maintained by the mineowners in most cases even though it was stated that it is a joint responsibility of the Public Works Department and the mine-owners. These roads urgently need widening and asphalting if the present ore movement is to be maintained. Transport of ore from the mines during the monsoon is almost at a stand still and consequently the production has to be curtailed to a minimum. The total length of all mining roads in Goa is about 100 miles.

Transportation of ore from the belt of Sancordem is a problem because of poor roads ; there is no rail link.

Camburjua Canal

A major inadequacy is the continuous silting of the navigable rivers—Mandovi, Zuari and Usgao affecting the smooth and quick movement of the barges particularly during the low tide. During the monsoon all the export traffic take a diversion of 17 kms along the Camburjua Canal, as the Aguada Bay at the confluence of Mandovi river with the Arabian sea is hazardous. But this canal has a depth of less than a metre near the Camburjua village during the low tide. Also, the mouth of the canal in the Mandovi river is not adequate for two-way traffic. It is reported that the barges have to wait for 3 to 4 hours to pass through this canal. The deepening of the canal would considerably reduce the long waiting time. This would also enable switch-over to large barges of 1000 tonne capacity and bring about a substantial reduction in transport cost. With the deepening of the canal the transport cost per tonne of ore by barges of thousand tonne capacity will be only Rs. 3.83 compared with the present figure of Rs. 4.66 and for less than 1,000 tonne barge the cost per tonne of cargo will come down to Rs. 4.71 from Rs. 4.96.

2.7 Marketing

2.7.1 Almost the entire production from Goa is exported to Japan (95%) and some European countries through Marmagao Port. Goa ranks first among the States exporting iron ore and contributes more than 50% to the total quantity exported from India even though by value it is much less because of the exports of fines and low grade ore. The export trade is channelled through private exporting house except in the case of export to the East European Countries which is handled by the MMTC. Exports are generally against long terms contracts, but spot contracts are also negotiated for small lots. Most of the exporters meet 50 to 90% of their commitments from their own mines. Most of the small mineowners sell their produce to the exporters. The medium scale operators either export directly or seek the help of the MMTC.

Major Exporter

2.7.2 Both lumpy ore and fines are exported. The bulk of the lumpy ore exported is of 58—60% Fe content and the fines average 63% Fe. In recent years there has been a growing demand for fines from Japan. Goa exported 5.4 MT of fines and 0.49 MT of pellets in 1970. Exports from Goa since 1965 have been increasing except in the years 1967 and 1968.

Table 2.7.1 : Quantity Authorised for Exports

Year	Qty. Exports (MT)
1965	7.0
1966	7.3
1967	6.9
1968	6.7
1969	7.6
1970	8.4

Source : Directorate of Industries & Mines, Goa.

2.7.3 *Credit Facilities.* Loans are available from the Maharashtra State Financial Corporation (MSFC), State Directorate of Industries and Mines (D of I & M), State Bank, Local Commercial Banks, etc. The Maharashtra State Financial Corporation provides loans of upto 1 million for private individuals and partnership firms and Rs. 2 million for public undertakings and co-operatives at 7% interest. The loan is repayable in ten years in 17 half yearly instalments. The first instalments falls due 10 years after the date of the drawal. While scrutinising the application of the mineowner, the corporation obtains detailed information from the Director of Industries and Mines.

Since April 1970, the Directorate of Mines and Industries, Goa, has also started giving loans to small mines where the investment in plant and machinery does not exceed Rs. 0.75 million. The loan is available under the scheme of the Rural Industries Project, at an interest of 3%. The maximum loan that a mine-owner can obtain under this scheme is Rs. 25,000/- and the loan is repayable in 15 years, the first instalment falling due on the sixth anniversary of the drawal. The Directorate also provides loans at an interest of 6% and the maximum limit for such a loan is Rs. 100 thousand. However, there has been very little response for both the schemes. It appears that either the mineowners are not interested in taking such loans or are not aware that such loans are available with MSFC, D of I & M and local commercial banks. The attitude of the smaller mineowners met during the survey was one of lack of interest in obtaining loans at high interest rates. The bigger operators, however, find the loan amount insufficient and would like to obtain a sizeable loan for their expansion programmes. Another reason why these loans have not been utilised is because most of the mineowners excepting a few are exporters and adequate credit facilities are available for exports.

Credit Facilities not utilised

2.8 Future Prospects

2.8.1 Export trade is expected to be the mainstay of the iron ore industry in Goa. Mineowners encouraged by the increasing trend in exports have long range plans for mechanising the existing mines to increase production and develop new mines to meet their contract commitments.

Improvement of Facilities at Marmagao Port

2.8.2 Work has been in progress since February 1970 for the improvement of facilities at the Marmagao harbour. Work of dredging of the harbour from the present 9 metres to 16 metres has been started. This work forms a part of a massive Rs. 280 million development project scheduled to be completed by the end of 1971. Once completed the harbour will be able to accommodate initially ore carriers of 60,000 dwt size. The depth is to be increased subsequently to accommodate 100,000 dwt vessels. A new ore berth with a loading plant of capacity 8,000 tonnes per hour is to be constructed along with a new oil berth.

2.8.3 A mobile pier is to be installed with a storage capacity of 20,000 tonnes and would be capable of handling 10,000 tonnes/hr. The $ 3 million mobile pier, the first of its kind in India, would be set up in Marmagao harbour to ensure quicker turn-around of the vessels. The cost of the pier is to be met through ore shipment.

3. MANGANESE ORE AND BAUXITE

Manganese ore

3.1 Goa contributes 5.4% by value and 12.2% by quantity to the total manganese ore production in the country. Goa's production is predominantly ferruginous ore. There were 114 mines with a total production of 202 thousand tonnes with

ferruginous ore constituting 86% of the total manganese ore production. Almost the entire production of ferruginous ore is exported and the medium grade manganese ore is consumed by local industries.

Bauxite

3.2 Goa contributes 5.5 % by value and 5.4% by quantity to the total bauxite production in the country. Large deposits of bauxite have reported in southern Goa. Bauxite occurs on a flat to gently sloping plateau. Analysis of samples collected from bauxite outcrops has indicated 45-60% $Al_2 0_3$, 2—8 % Sio_2 and 5-13% Fe. Explorations and investigations are still being carried out. The Government has reserved the potential bauxite bearing zones for exploitation in the public sector. There were 5 mines in Goa in 1970 with a total production of 74 thousand tonnes, 90% of which was exported.

CHAPTER IV—GUJARAT

1. INTRODUCTION

1.1.1 Gujarat occupies a very significant position in the mineral map of India. The State is the largest producer of petroleum and natural gas in the country. Gujarat's contribution to the total value of major minerals produced in the country amounted to 9.6% in 1970. The State ranked fourth in 1970 among the mineral producing States in India. However, the State's contribution to the production of metallic and non-metallic minerals is not very significant. The State's contribution to the total value of production of the minerals under study is a meagre 0.7% (Table 1.1.1). The State has some of the best deposits of graphite, fluorite, limestone, clay and dolomite which are awaiting effective exploitation.

1.1.2 Bauxite was the only mineral from Gujarat State that was included in the survey of mines. A brief note on the status of the lead-zinc deposit in Ambamata-Dariba and the manganese ore industry in the State has also been provided.

Table 1.1.1 : Share of Gujarat in the Mineral Production of India, Major Minerals and Minerals Under Study

(In million rupees)

Year	Major Minerals			Minerals Under Study		
	India	Gujarat	% Share	India	Gujarat	% Share
1966	2,917.1	245.2	8.4	419.1	2.1	0.5
1967	3,317.1	302.6	9.1	449.0	1.7	0.4
1968	3,810.4	323.5	8.5	499.8	1.8	0.4
1969	4,240.3	406.7	9.6	512.2	3.4	0.7
1970	4,296.3	414.3	9.6	558.0	4.0	0.7

Source : IBM—Mineral Statistics of India, January 1971.

2. BAUXITE

2.1 Geology and Reserves

2.1.1 The bauxite deposits of Gujarat occur in the form of a narrow belt varying from 100 metres to 3 kms in width roughly following the western coastline of the State. Towards the interior, patches of laterite carrying pockets of bauxite occur over a distance of 150 kms from Harsol in Sabarkantha district to Tadkeshav in Bulsar district. In northern Kutch, bauxite occurs in the islands of Patcham, Bela and Khadir and the belt continue into the adjoining Rapur and Santalpur areas.

2.1.2 Large deposits of bauxite specially suited for manufacture of alumina (occurrence of gibbsite—trihydrate of aluminium) are found in the Jamnagar and Kutch districts. Pockets of bauxite in the Jamnagar district occur in a continuous horizon of laterite forming low isolated hills along the narrow strip running for more than 48 kms from Virpur, near the Gulf of Kutch to Hamba, near the Arbian Sea in Kalyanpur Taluk. In Kutch district the chief bauxite deposits occur in a 1.5 km wide strip stretching over a length of 100 kms along the southern and western coasts of Kutch.

Jamnagar District

2.1.3 A total of 7.35 MT of reserves have been estimated for Jamnagar district. Out of this a major portion of about 5.7 MT occurs in a compact area in Ran. The alumina content of the ore varies from 60% to 63%. The total reserves in Kutch are of the order of 7.35 MT with an average of 55-57% alumina out of which the low silica ores (2-2.8% SiO_2) are understood to be around 6 MT. Reserves estimated so far in the six deposits of Bhavanagar and Amreli districts is about 0.146 MT. However, additional reserves are expected in the deposits occurring under the cover of the younger sedimentaries. A reserve of 0.27 MT and 0.16 MT for Sabarkantha and Kaira districts respectively has been estimated.

Table 2.1.1 : Reserves of Bauxite in Gujarat

District	Grade	Reserves
Total	5[illegible]%	14.91
Jamnagar	51-55%	7.35
Kutch	55-57%	7.50
Bulsar	52%	0.06

Source : GSI.

2 2 Structure of Bauxite Mines in Gujarat

2.2.1 Bauxite mining in Jamnagar district has been since the beginning with the private industry. However, with the formation of the State of Gujarat the non-leased areas in Jamnagar district and the complete Kutch district have been reserved by the Government with a view to conserve the mineral. The Gujarat Mineral Development Corporation, a Government of Gujarat undertaking, has recently started mining in a small scale in these areas.

2.2.2 Bauxite mining in Jamnagar district is just quarrying. Bauxite occurs at a depth of 4 ft. to 40 ft. in concentrated pockets. These concentrated pockets are widely spread and do not have any continuity. Thus the scope for mechanising these small pockets or having a single mechanised mine in a lease area is uneconomical and impracticable. Mechanisation is limited to the extent of having mechanical handling facilities like bulldozers, excavators,

Mechanisation

trolley lines, etc. However, use of bulldozers and excavators in this region is very limited as the upper layers of the overburden contain hard rocks with layers of laterite (high ferrous alumina), soft clay and hard bauxite. Use of trolley lines has been found to be economically justifiable only in larger pockets with big ore deposits. It might be added here that of the 10 mines the study team visited only two mines have compressors for drilling holes and only one mine has a trolley line for disposing of the overburden. In all the other mines the work was being done manually. The average productivity in these semi-mechanised mines is 0.6 tonnes/man day compared to 1.1 tonnes/man day in the non-mechanised mines. The lower productivity is because of the huge overburden in these mines.

2.3 Production Trend and Grade Structure

Increase in Number of Mines

2.3.1 There has been a steady increase in the number of mines in the country and in Gujarat State. In the State there were 26 mines in 1970, as against 8 mines in 1966. During the corresponding period the number of mines in all India, increased from 34 to 68.

Erratic Production

2.3,2 Gujarat's contribution to the all India production of bauxite dropped from 23.2% in 1969 to 17.0% in 1970. The drop in the State's share has been due to increased production in Madhya Pradesh and Bihar. Bauxite production in Gujarat State has been quite erratic. From a production of 295 thousand tonnes in 1962 it fell to 108 thousand tonnes in 1964, again rose to 180 thousand tonnes in 1965 and dropped to 130 thousand tonnes in 1967. The production has stabilised itself in the last two years around 245 thousand tonnes.

Grade

2.3.3 Bauxite mined in Gujarat is graded as high, medium and low depending on the alumina content in the ore. High grade ore which is mined in Jamnagar is low in silica and iron content and is preferred by the chemical industries. Low calcium, low titanium and low iron is preferred by the refractory and abrasive industries. The ore mined by the mineowners is in general dependent on the end use and the demand for the particular grade.

Beneficiation

2.3.4 Beneficiation of bauxite is limited to washing. Washing of the low grade ore is generally carried out to remove the impurities. However, this is very uneconomical in Jamnagar district due to lack of availability of large quantity of water and the problem of waste disposal.

Table 2.3.1 : Number of Operating Mines, All India and Gujarat, 1966-70

Year	All India	Gujarat
1966	34	8
1967	36	11
1968	41	16
1969	59	25
1970	68	26

Source : 1. DGMS—Statistics of Mines in India, Vol II, Non-Coal, 1966, 1967 and 1968.

2. IBM—Mineral Statistics of India, January 1971.

Table 2.3.2 : Production of Bauxite, All India and Gujarat (1961-70)

(Quantity in thousand tonnes)

Year	All India	Gujarat	
	Qty.	Qty.	% Share
1961	475.9	249.5	52.4
1962	586.8	295.1	50.3
1963	566.7	183.1	32.4
1964	593.5	108.0	18.2
1965	706.6	180.3	25.5
1966	749.9	171.8	22.9
1967	804.1	130.8	16.3
1968	957.6	151.3	15.7
1969	1,063.0	247.5	23.2
1970	1,434.6	244.5	17.0

Source : IBM—Mineral Statistics of India, January 1971.

2.4 Cost and Price Structure

2.4.1 The bauxite deposits of Kutch and Jamnagar are situated within 100 metres of the sea level. Most of the deposits are exposed and the rest have minor overburdens. These factors together with the easy accessibility render them amenable for simple and cheap methods of opencast quarrying. Bauxite mining in Gujarat is a labour intensive industry. The cost structure of the surveyed units shows that the labour component of the mining cost is over 80%. This is because most of the mines are non-mechanised. The mining cost of the surveyed units range from Rs. 8 to Rs. 10/tonne. The cost of transporting the ore from the mine to the railhead varies from Rs. 2 to Rs. 5/tonne depending upon the lead from the mine to the railhead. Table 2.4.1 shows the different costs incurred by a particular operator in Jamnagar district.

Labour Intensive

Table 2.4.1 : FOR Cost and Different Cost Components for a Particular Mineowner in Gujarat

Components of Cost	(Rupees/tonne)
Total cost	23.75
Mining	10.00
Sorting & Grading	2.50
Salary of Supervisory staff	2.50
Royalty	2.50
Loading/unloading charges	1.25
Transportation charges to Bhatia Station	5.00

Source : ORG Mineral Survey.

2.5 Marketing and Transportation

Largest Exporting Sector

2.5.1 Most of the bauxite exported by the country is Gujarat ore. The location of the deposit in close proximity to Okha port and low cost of transportation compared to other regions has facilitated exports. The balance after exports is consumed by the chemical industries around Ahmedabad, Bombay and Delhi, by some of the cement factories in Gujarat and by abrasives and refractory industries in India. Exports take place from the Port Okha (50 miles from Bhatia) and Porbandar (40 miles from Bhatia). The roads to these ports are good. However, inadequate handling and loading facilities at these two ports have limited the exports. At present, Port Okha can handle about 800-900 tonnes a day. It is estimated that the port should have a handling capacity of at least 3,000 tonnes a day to meet the present requirements of the mineowners.

2.5.2 Bauxite exported reached a peak in 1962 and was valued at more than Rs. 8.5 million. Thereafter there was a continuous decline up to 1965. Export in 1965 was Rs. 1.8 million. Since 1968 there has once again been a steady increase with exports amounting to 80 thousand tonnes of bauxite. However, with the increase in freight the export market for low grade bauxite has suffered. The transportation cost is higher than the production cost. Increases in the freight cost have made the Indian bauxite less competitive and there is a likelihood that Australia, Greece and Yugoslavia might capture the European and Japanese markets.

2.5.3. Transportation is the biggest problem faced by the mineowners. The roads from the mines to the highway (distances vary from 1 km to 15 kms) are very poor. During the monsoon season there is no mining activity because of flooding and poor surface condition of the roads. The closure of the mines is a regular future every year, for periods varying from a month to four months. Bauxite is transported by rail from Bhatia and Bhopalka stations. Storing facilities at these stations are highly inadequate and it is suggested that the railway authorities provide more plots for stacking the ore and also provide adequate wagons for the transportation of the ore to the port. Non-availability of the required number of wagons and improper handling facilities at these stations are the other problems faced by the mineowners. It is suggested that at least sixty wagons be reserved and allotted each day for bauxite at these railway stations.

Table 2.3.1 : Transportation and Port Charges from the Mine to the Okha Port for a Particular Mineowner in Gujarat. Cost/Tonne

Components of Cost	Rs.
Total Cost	27.50
Loading charges at mines	0.50
Transport from mines to Okha Port	17.00
Unloading charges	0.75
Plot rent at port	0.75
Port handling charges etc.	8.50

Source : ORG Mineral Survey.

3. Lead—Zinc And Manganese

3.1 Search for base metals is being carried out in several areas in Baroda and Panchmahal districts. Geological and geochemical investigation at Khandia, Baroda district, has indicated the occurrence of lead-zinc mineralisation with a strike length of 1,800 metres. Primary analysis has indicated a small reserve of 0.22 MT of ore with an average of 4.5% metal content. **Lead-Zinc**

3.2 Detailed surface investigations in Ambamata are going on since the middle of 1969. On the basis of intersections of mineralised zones so far obtained a reserve of 5.5 MT has been calculated. The ore is expected to have an average metal content of 10.8%, mainly lead and zinc and significant amounts of copper also. Exploration is in progress to find out further extensions both laterally and at depth, and this when completed is bound to result in establishing substantial additional reserves. The surface exploration is expected to be completed by the end of 1971. The GMDC has started developing a mine in this region. Productive mining is to start once a depth of 300 metres is reached.

3.3 The Ambamata prospect alone can sustain a rate of mining and mill concentration of the order of 750 TPD of run-of-mine ore for over a period of 20 years. The total yearly production is expected to be 11,000 tons of lead, 11,000 tons of zinc and 2,500 tonnes of copper. The saving in foreign exchange is likely to be Rs. 70 to 80 million annually.

3.4 The once active mining of manganese ore in the Shivrajpur-Pani mine belt has now been closed due to various reasons. It is reported that the ore persists at further depths in the Shivrajpur-Bamankua area but it is reported that the mining has become uneconomical due to depth of working and the high phosphorus content of the manganese ore. **Manganese**

The manganese mining activity can be revived if there is a ready market for high phosphorus ore and if blending of the ore with other grades produced in different parts of the country is attempted.

CHAPTER V—MADHYA PRADESH

1. INTRODUCTION

Major Role

1.1.1 In the mineral economy of India, position of Madhya Pradesh is very significant. It ranks third (next only to Bihar and West Bengal) among the mineral producing States of India. Its contribution to total mineral production of the country is about 15% (Table 1.1.1). About 75% of its mineral production consists of coal.

Table 1.1.1 : Share of Madhya Pradesh in the Mineral Production of India. All Minerals and Minerals Under Study, 1966-70.

(Million Rupees)

Year	All Minerals			Minerals Under Study		
	India	M.P.	% Share	India	M.P.	% Share
1966	2,917.1	403.0	13.8	419.1	57.2	13.6
1967	3,317.7	488.5	14.7	449.0	69.7	15.5
1968	3,810.4	546.7	14.3	499.8	82.8	16.6
1969	4,240.3	580.5	14.0	514.2	93.1	18.1
1970	4,296.3	626.7	14.6	558.0	110.2	19.9

Source : IBM—Mineral Statistics of India, January 1971.

Madhya Pradesh's contribution to the total mineral extraction of the country increased by 0.8%. Total increase in the value of mineral production during this period was about Rs. 220 million. Major part of the increase was accounted for by coal. The next came from iron ore. Iron ore production increased by more than 200%.

Iron Ore the Most Important Mineral

1.1.2 Iron ore is the most important non-coal mineral of Madhya Pradesh. This constitutes about 82% of the non-coal mineral production of the State. Of the minerals under study, other two minerals produced in the State are manganese ore (16%) and bauxite (2%). Manganese ore production in Madhya Pradesh declined by about 35% during 1966-70. Relative shares of individual minerals in the total production of minerals under study in Madhya Pradesh is shown in Table 1.1.2.

Table 1.1.2 : Production of Minerals Under Study in Madhya Pradesh and Shares of Individual Minerals, 1970

Mineral	Production	
	Million Rs.	% Share
Total	110.2	100.0
Iron ore	89.9	81.5
Manganese ore	17.8	16.2
Bauxite	2.5	2.3

Source : IBM—Mineral Statistics of India, January 1971.

2. IRON ORE

2.1 Geology and Reserves

2.1.1 Madhya Pradesh, with 2,438 MT occupies a second place in the country's total iron ore reserves, the first being Orissa. Almost the entire reserve is of hematite ore. Occurrences of iron ore have been reported in several districts of the State. But the districts having high concentration of ore are Bastar, Durg and Jabalpur. More important pockets are found in the fourteen isolated deposits of Bailadila range running north-south and the deposits near Rowghat and Aridongri in Bastar district and around Dhalli-Rajhara in Durg district. Ore in these two districts is of high grade, the iron content in some places going up to 69%. In Jabalpur district, the ore is micaceous and siliceous hematite and is generally of low grade (45-60% Fe). The silica content is usually more than the alumina content.

Second Place in Reserves

2.2 Structure of Iron Ore Mines in Madhya Pradesh

2.2.1 The few mines that exist in this State belong to public sector. During 1970 there were seven mines of which six were the captive mines of Hindustan Steel Ltd., Bhilai and one belonged to the National Mineral Development Corporation. The mines, although few in number, are big in size, the smallest mine having a production of 72 thousand tonnes of ore per year. This State takes pride in having the largest mechanised mine in Asia, at Bailadila.

Public Sector Venture

2.2.2 The degree of mechanisation in the mines is greater as compared to any other State. Of the seven mines, two are fully mechanised while the rest are semi-mechanised. The range of production per mine varies from 72 thousand tonnes to 3.5 MT per year. Most of the mines produce more than hundred thousand tonnes of ore per year. In a majority of the mines, the average daily employment is more than one thousand.

2.3 Production and Grade Structure

2.3.1 There has been no significant change in the number of mines operating in this State over the past few years. But in terms of production the growth rate has been spectacular. In 1960 iron ore production in Madhya Pradesh was only 1.4 MT. This was less than 9% of the country's total production (Table 2.3.1). Within a period of ten years production has increased by five times. Presently, the seven mines of this State, by producing more than 7 MT of ore, account for about 23% of the total production. This has placed Madhya Pradesh next to Goa in iron ore production in the country.

Table 2.3.1 : Production of Iron Ore—All India and Share of M.P., 1961-70

	All India	Madhya Pradesh	
Year	Qty. (MT)	Qty. (MT)	%
1961	17.8	2.3	13.0
1962	19.1	1.9	9.8
1963	21.1	2.3	11.1
1964	21.9	2.9	13.2
1965	23.9	2.8	11.6
1966	26.7	4.0	14.9
1967	25.9	4.6	17.6
1968	28.0	5.4	19.3
1969	29.2	6.4	21.9
1970	30.8	7.2	23.3

Source : IBM—Mineral Statistics of India, January, 1971.

2.3.2 As regards quality of ore, most of the ore produced are of high grade i.e., above 62%. Ore produced in Bailadila mine is invariably above 66%. Production of fines in the mechanised mines of Rajhara and Bailadila varies from 40 to 50% of the total production. Fines produced in captive mines are despatched to the sintering plant for agglomeration. The mine at Bailadila does not have any outlet for its fines.

2.4 Processing of Iron Ore

Beneficiation Not a Major Problem

2.4.1 Improving the grade of ore is not a major problem in this State since the ore produced is generally of high grade. Nevertheless the two ore dressing plants that exist in the two fully mechanised mines contribute to the improvement of the grade. As regards utilisation of fines, the sintering plant attached to the Bhilai Steel plant consumes a part of the fines satisfiying the specification for sintering. Fines other than those used for sintering do not have any outlet.

The National Mineral Development Corporation of India has been studying the possibility of setting up a pelletisation plant to utilise the fines produced at its mine at Bailadila.

2.5 Cost and Price Structure

2.5.1 Mining cost of iron ore in Madhya Pradesh, although showing an increasing trend over the past five years, does not reveal much variation among the mines. During 1970 such cost ranged between Rs. 5/- and Rs. 7/- (Table 2.5.1).

Table 2.5.1 : Mining Cost of Selected Mines in Madhya Pradesh, 1966-67 to 1970-71

S. No.	Type	Mining Cost (Rs./Tonne)				
		1966-67	1967-68	1968-69	1969-70	1970-71
1	M	—	—	—	6.16	6.51
2	M	3.67	3.84	3.08	5.87	7.48
3	N*	4.61	4.79	4.93	5.42	5.46

M=Fully mechanised N=Not fully mechanised

* Cost data refer to the average cost of five mines as data for individual mines were not available.

Source : ORG Mineral Survey.

2.5.2 Contrary to usual expectation, the mining cost in fully mechanised mines does not appear to be less than in those mines which are not fully meehanised. In certain years mining cost in mines without full mechanisation is less than the cost in fully mechanised mines.

2.5.3 There has been wide difference in the f.o.r. costs of fully mechanised mines and those not fully mechanised. The lower and upper limits for these two groups are Rs. 14/- and Rs. 23/- respectively. The main reason for a higher f.o.r. costs in fully mechanised mines is high fixed cost components such as depreciation, interest and office overhead.

2.5.4 Data on f.o.r. price realisation are not available as the captive mines do not maintain it. As regards marketing of ore from Bailadila, the terms of contract are on f.o.b.t. It may be mentioned that the f.o.b.t. realisation of this mine is noticed to be marginally lower than the f.o.b.t. cost. The reasons for this loss are high freight charges, under-utilisation of the ore dressing plant and absence of an outlet for the huge quantities of fines produced. The plant has been working below its capacity to the tune of 1.5 MT. Although more than a million tonne of fines are produced every year, there has been no market for them. Freight charges are about 50% of the f.o.b.t. cost.

2.6 Marketing and Transportation

No Diversified Market

2.6.1 The mines in Madhya Pradesh do not have diversified market. The entire produce of the captive mines is used in the Bhilai steel plant whereas ores from Bailadila are shipped to Japan via Vishakhapatnam port as per a long term contract.

2.6.2 Both the fully mechanised mines of this State are having railway sidings inside the lease area whereas the other mines depend upon the railway siding of the Rajhara mechanised mine for transport ; the distance varies from 5 kms to 25 kms. By rail the distance of Bhilai Steel plant from Rajhara railway siding is about 85 kms. But the Vishakhapatnam port is as far as 475 kms from Bailadila. While the Rajhara group of mines sometimes face acute shortage of wagons, no such problem is reported in Bailadila. In fact the rail link between Kirindul (railway siding of Bailadila mine) and Vishakhapatnam port has been underfed. Although the link can handle 12 trains a day, the present traffic has been limited to only 6 trains in summer and 3 trains in rainy season. Presently the concessional freight charges paid by the mine for transporting ore from Kirindul to Vishakhapatnam port is as high as Rs. 35/- per tonne.

2.7 Future Prospects

Ambitious Future Production Plans

2.7.1 The future of iron ore development in Madhya Pradesh rests with the public sector which has ambitious production plans in ensuing years. A gigantic plant with the same capacity as that of the present mine at Bailadila (deposit No. 14) is in the process of installation of Bhansi (deposit No. 5 in Bailadila range). A feasibility study regarding establishment of a pelletisation plant at Bailadila is under preparation. The captive mine of Hindustan Steel Ltd. at Dalli has plans for making the mine fully mechanised so as to achieve an output of 2.5 MT per year. If all the plans materialise, then by the end of 1974 Madhya Pradesh is sure to surpass Goa in iron ore production and stand first in the country's total production.

2. MANGANESE ORE

2.1 Introduction

Manganese ore deposits in Madhya Pradesh and Maharashtra occur in a continuous belt extending over the districts of Chindwara, Nagpur, Bhandara and Balaghat. An analysis of the mining industry in this belt has been provided in the following pages. Analysis of the manganese ore industry of the two States, Madhya Pradesh and Maharashtra, has not been done individually as the nature of deposits, mining activity and problems are similar over the whole belt.

2.2 Geology and Reserves

2.2.1 The manganese belt of Chindwara—Nagpur—Bhandara—Balaghat districts of Madhya Pradesh and Maharashtra is most important in India from the point of view of quality and also the extent of reserves and actual production. The manganese ore deposits of Chindwara, Nagpur, Bhandara and Balaghat districts of Madhya Pradesh and Maharashtra occur in an arcuate belt 130 miles long and 16 miles wide. There are more than 200 individual deposits within the belt, of which 20 are major producing deposits. The reserves of ore containing 30 to 40% manganese are estimated at about 12 MT per 100 ft. down dip extension in the 17 major deposits along the belt. Both measured and indicated reserves in these deposits are estimated at about 20 MT. Inferred reserves are of the order of 142 MT of ore out of which 75 MT are, probably, of metallurgical grade with 48% manganese content. Characteristic features of these ores are their low iron content and lumpy nature. Of the total reserves in Madhya Pradesh—Maharashtra belt, proved reserves in Madhya Pradesh (Balaghat district) are about 6 MT, measured and indicated reserves about 11 MT and total inferred reserves about 65 MT.

2.3 Structure of Manganese Ore Mines in Maharashtra and Madhya Pradesh

2.3.1 Assessed in terms of total mining activity and production, the public sector in Madhya Prrdesh and Maharashtra makes a larger contribution than the private sector, although assessed in terms of the number of mines working, the industry is dominated by small private operators. The only public sector unit operating is Manganese Ore (India) Ltd. (MOIL). MOIL accounts for about 60% of the total manganese ore production in Maharashtra and for almost the entire production in Madhya Pradesh. MOIL is at present operating 7 mines in Maharashtra of which 5 are mechanised and 4 in Madhya Pradesh of which 3 are mechanised. Of these, 6 mines have both opencast and underground workings, one has only opencast working and the other only underground working. Most of the mechanised mines have more than one working pit. The biggest mine is working in as many as six pits. Mechanical methods used in the mines are for drilling, haulage, pumping and ventilation.

2.3.2 With the exception of the Dongri Buzurg mine of Central Provinces Manganese Ore Co. Ltd., manganese mining in the private sector in Maharashtra and Madhya Pradesh consists of a number of small operators. At present, there are 26 and 24 mines in Maharashtra and Madhya Pradesh respectively operating in the private sector. These mines are based on opencast workings and are either non-mechanised or semi-mechanised.

2.4 Production Trend and Grade Structure

2.4.1 Assessed in terms of production, manganese ore mining in this belt flourished during 1963-66, experienced a period of depression during 1967-69, **Fluctuating Production**

and started picking up during 1970. Its share in all India production also fluctuated accordingly (Table 2.4.1).

Table 2.4.1 : Production of Manganese Ore in India, Maharashtra and Madhya Pradesh, 1961-70

Year	Production (thousand tonnes)				
	All India	Maharashtra		Madhya Pradesh	
	Qty.	Qty.	% Share	Qty.	% Share
1961	1,405	178	12.7	227	16.3
1962	1,636	167	10.2	232	14.0
1963	1,316	146	11.1	235	18 2
1964	1,407	224	16.0	277	19.8
1965	1,647	317	19.2	302	18.2
1966	1.710	340	19.9	330	19.3
1967	1,617	329	20.4	297	18.5
1968	1,610	291	18.1	258	16.1
1969	1,485	163	11.0	184	12.1
1970	1,651	214	13.0	214	12.7

Source : IBM—Mineral Statistics of India, January 1971.

2.4.2 Fluctuations in production of Maharashtra reflect the parallel fluctuations in the production of the public (MOIL) and private sectors. Production in the private sector declined from about 230 thousand tonnes to 135 thousand tonnes during 1967-68 and the downward trend continued till it started picking up in 1970. Decline in production of the public sector during 1967-69 is due to setback in exports of MOIL. Number of working mines and production of public and private sectors in Maharashtra are shown in Table 2.4.2.

Table 2.4.2 : Number of Working mines and Production of Manganese Ore in Public and Private Sectors in Maharashtra during 1966-70

Year	No. of Working Mines	Production (thousand tonnes)				
		Total	Public Sector		Private Sector	
		Qty.	Qty.	% Share	Qty.	% Share
1966	53	340.2	175.2	51.5	165.0	48.5
1967	56	329.4	230.3	69.9	99.1	30.1
1968	48	291.2	134.8	46.3	156.4	53.7
1969	59	163.0	97.6	59.9	65.4	40.1
1970	33	214.4	124.3	58.0	90.1	42.0

Source : (1) DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1966, 1967 and 1968.
(2) IBM—Mineral Statistics of India.
(3) ORG Mineral Survey.

Decline in production since 1966 in Madhya Pradesh is mostly due to the decline in production of the private sector. Production of this sector declined by about 113 thousand tonnes (95%)—from 118,800 tonnes in 1966 to 5,700 tonnes in 1970. The decline in production was brought about by a sharp decline in the number of working mines during this period. Number of working mines and production of public and private sectors in Madhya Pradesh during 1966-70 are shown below (Table 2.4.3). Diminishing share of the private sector is mostly due to the change in ownership of a large number of mines of Central Provinces Manganese Ore Co. Ltd. (CPMO), which was the largest mineowner in Madhya Pradesh. All the mines of CPMO were taken over by MOIL.

Table 2.4.3 : Number of Working Mines and Production of Manganese Ore in Public and Private Sectors in Madhya Pradesh, 1966-70

Year	No. of Working mines	Production (thousand tonnes)				
		Total	Public Sector		Private Sector	
			Qty.	% Share	Qty.	% Share
1966	81	330.0	211.2	64.0	118.8	36.0
1967	73	297.0	209.3	70.4	87.7	29.6
1968	54	258.0	187.2	72.6	70.8	27.4
1969	58	184.0	167.8	91.2	16.2	8.8
1970	28	214.0	208.3	97.3	5.7	2.7

Source : (1) DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1966, 1967 and 1968.

(2) IBM—Mineral Statistics of India, January, 1971.

(3) ORG Mineral Survey.

2.4.3 As mentioned in Section 2.1.1, manganese ore produced in Madhya Pradesh and Maharashtra is characterised by high commercial grades. Although by tonnage Orissa accounts for highest production of manganese ore in India, by unit value, Madhya Pradesh and Maharashtra occupy the first two positions because of predominance of ore of high commercial grades (above 44% Mn). **High Grade**

2.5 Ore Beneficiation

2.5.1 As mentioned in Part III, Chapter II, while discussing manganese ore, in spite of the increasing realisation about the need for beneficiation of low grade manganese ore in India, only two plants have been set up so far. One is the heavy media separation plant at Dongri-Buzurg mine of CPMO Co. Ltd., in Maharashtra, set up in 1954 and the other is the beneficiation plant of M/s. Sreeram Durgaprasad Garividi Mines in Srikakulam district of Andhra Pradesh. MOIL is contemplating a beneficiation plant at the Balaghat mine. The company

is at present, working out the cost-benefits of plants of different capacities. Once the Balaghat plant is installed and it works satisfactorily the company will consider the case for installation of similar plants in the other major mines.

Present Practices of Beneficiation

2.5.2 The beneficiation practices generally followed in India, and in Maharashtra and Madhya Pradesh, at present, comprise of hand sorting and picking, manual jigging (in some cases mechanical) and washing. Estimated costs of the different processes of beneficiation are shown below.

Table 2.5.1 : Cost of Manual Beneification

	Cost Rs./Tonne of Concentrate
1 Breaking and sorting	5.00
2 Jigging	5.00
3 Washing	2.50

Source : ORG Mineral Survey.

2.6 Cost and Price Structure

Wide Variation in Unit Cost

2.6.1 The cost of mining of manganese ore varies rather widely, depending on the richness of deposits, depth of the mine, nature of working (opencast or underground), the ratio of ore to waste and the scale of operation (the level of production). Inter-mine variations in costs will be evident from Table 2.6.1. The table shows variations in unit mining costs of a cross section of open cast and underground mines, mechanised, semi-mechanised and non-mechanised mines at different production levels—in Madhya Pradesh and Maharashtra during 1969-70.

Table 2.6.1 : Unit Mining Cost of selected Manganese Mines in Maharashtra and Madhya Pradesh and their Production Levels, 1969-70.

S. No.	Maharashtra		Madhya Pradesh	
	Production (In thousand tonnes)	Mining Cost (Rs./tonnes)	Production (In thousand tonnes)	Mining Cost (Rs./tonnes)
1	1.0	18.93	1.5	22.27*
2	2.2	32.77	2.1	25.38*
3	7.3	9.06	4.9	12.75
4	11.5	27.23	6.2	15.66
5	12.5	18.99	13.8	21.89
6	15.1	25.00	64.5	32.32
7	19.0	11.18	74.8	14.63

* Relate to 1968-69.

Source : ORG Mineral Survey.

2.6.2 Because most of the manganese mines are opencast workings and mostly non-mechanised (at best semi-mechanised), mining becomes a highly labour intensive process. In case of mechanised mines, in addition to labour, power and fuel is an important input. Explosives also constitute a major mining input. Movements in costs of these inputs are likely to have direct impact on the total mining cost. But, the trend in unit mining cost of the surveyed mines does not bear evidence to this. In spite of the increasing labour costs and prices of other major mining inputs, the table 2.6.2 a & b show a mixed trend in unit mining cost. This indicates that it will be wrong to assess the increase in costs only in terms of increase in costs of inputs. The changes in important related factors—such as the richness of depoists, depth levels, method of operation (mechanised or non-mechanised), nature of working (opencast or underground), etc.—which influence the cost of mining operations at any point of time need also to be taken into consideration.

No Fixed Trend in Unit Cost

Table 2.6.2a : Trend is Unit Mining Cost of Selected Manganese Ore Mines in Madhya Pradesh, 1965-66 to 1969-70

S. No.	Mining Cost (Rs./Tonne)				
	1965-66	1966-67	1967-68	1968-69	1969-70
1	35.11	31.15	20.92	22.27	NA
2	30.63	20.91	32.09	25.38	NA
3	16.51	10.50	10.79	13.19	12.75
4	22.03	22.82	13.27	NA	15.66
5	16.51	21.87	20.88	18.86	21.89
6	27.95	26.68	33.21	31.08	32.32
7	17.16	14.28	14.83	13.01	14.63

NA—Not available
Source : ORG Mineral Survey.

Table 2.6.2b : Trend in Unit Mining Cost of Selected Manganese Ore Mines in Maharashtra, 1965-66 to 1969-70

S. No.	Mining Cost (Rs./Tonne)				
	1965-66	1966-67	1967-68	1968-69	1969-70
1	NA	18.47	14.21	11.38	18.93
2	15.80	15.25	24.88	22.93	32.77
3	38.86	32.38	19.36	22.15	25.34
4	9.98	7.41	9.12	7.52	9.06
5	NA	17.40	17.50	12.42	13.45
6	NA	23.12	19.70	21.77	27.23
7	24.78	18.62	15.42	17.55	17.59
8	12.92	20.48	15.04	16.06	18.79
9	NA	27.86	20.95	29.02	25.00
10	25.78	19.09	8.87	12.95	11.18

NA—Not available
Source : ORG Mineral Survey.

2.6.3 Analysis of the price structure of some of the major mines surveyed reveals that domestic sales prices of high grade ores (46-48% Mn) did not register any increase during 1965-66 to 1969-70. The Table below shows the selling prices (f. o. r) of 46-48% Mn ores, for three different parties, of one of the leading mineowners in Madhya Pradesh during 1965-66 to 1969-70.

Table 2.6.3 : F.O.R. Selling Price of Manganese Ore (46-48% Mn, Partywise, of one of the Leading Mineowners in Madhya Pradesh during 1965-66 to 1969-70

Year	F.O.R. Selling Price (Rs./Tonne)		
	Party 1	Party 2	Party 3
1965-66	101.62	108.55	104.90
1966-67	106.69	111.80	107.66
1967-68	127.03	125.02	123.93
1968-69	111.31	103.33	101.54
1969-70	111.79	97.88	102.09

Source : ORG Mineral Survey.

2.6.4 Against the above trend in the domestic sale prices it will be observed that India's export realisation on high, medium and low grade ores all declined during the five year period 1965-66 and 1969-70 (Table 2.6.4). The decline in the average export prices of the medium grade ores was about 35% the maximum among all the three grades. The decline in the prices of high grade ores was about 18%. Export realisations on ferruginous ores showed the least fluctuation, the percentage decline between 1965-66 and 1969-70 being only about 10%.

Table 2.6.4 : Unit Value Realisations on Exports of High, Medium and Low Grade Ores from India during 1965-66 to 1969-70

Year	Unit Export Realisation (Rs./Tonne)		
	High Grade	Medium Grade	Low Grade (Ferruginous Ore)
1965-66	200.08	172.55	76.44
1966-67	190.16	142.66	64.57
1967-68	187.40	130.80	68.96
1968-69	178.15	125.70	73.20
1969-70	163.59	114.02	70.12

Source : Monthly Statistics of Foreign Trade, Government of India.

2.7 Marketing and Transportation

2.7.1 Manganese ore industry in India is export oriented. But, Maharashtra and Madhya Pradesh are exceptions to this. A large part of the production is marketed within the country. This is because production is dominated by high grade ores and these mostly cater to the demand of the ferromanganese units. In addition to the supply of high grade ores and oriental mixture to the ferro-manganese units, the States supply low grade to the Bhilai steel plant.

2.7.2 Export of manganese ore, except that of MOIL, is canalised through MMTC. MOIL's export does not exceed 20% of total exports. So, about 80% of export of manganese ore from India is canalised through MMTC.

2.7.3 The most pertinent problems concerning the mineowners in both internal marketing and exports are associated with transportation. The major problems of transportation relate to :

Transport Problems

(i) Cost of transportation from mines to the railway stations ;

(ii) Availability of wagons at the loading stations ;

(iii) Incidence of railway freight.

Road Transport

The cost of transportation from the mines to the railway station is dependent on two factors, first, the length of the approach road and second, the condition of the roads. In a majority of the cases, the mineowners are inconvenienced either by both or one of these factors and as a result the transportation cost becomes high. In all these cases, to increase the competitiveness of Indian manganese ore in the foreign markets, the cost needs to be reduced by either improving the condition of the existing roads or constructing new roads. Some important road links between mines and railway stations in Madhya Pradesh—Maharashtra, shown below, need to be improved to facilitate ore movement.

Road link	Length (kms)
1. Meghanagar—Kajlidongri	13
2. Ambajhari—Tirodhi	16
3. Khapa—Ramtex and Saoner	23

Non-availability of Wagons

Non-availability of railway wagons is reported to be a chronic problem. This has resulted in accumulation of large stocks at the railway sidings.

Incidence of Railway Freight

Railway freight constitutes an important element of the f.o.b.t. price of manganese ores. In Madhya Pradesh—Maharashtra, railway freight on high and medium grade ores constituted about 23% of the f.o.b.t. price during 1968-69. It is to be noticed here that while f.o.b.t. sales realisations on high and medium

grade ores decreased by Rs. 25 and Rs. 16 per tonne between 1967-68 and 1969-70, during the same period railway freight increased by from Rs. 2 to Rs. 15 per tonne.

2.8 Future Prospects

Exploration of Deposits

2.8.1 As has been discussed under "Manganese Ore" in Part II, Chapter III, there is need for immediate and extensive exploration and estimation of reserves of manganese ore in the country to increase future production. The proved reserves are, at present, confined to Madhya Pradesh—Maharashtra only. In fact, it is only in Madhya Pradesh—Maharashtra, that extensive geological mapping has been done and detailed exploration has been undertaken to a certain extent. It is encouraging to note here that MOIL is planning to undertake extensive exploration and proving operations in the existing lease areas.

Transport Problem

2.8.2 The most immediate problem facing the mineowners is associated with transportation. As has been discussed in section 2.7 transportation poses a problem at each phase of ore movement. Railway freight absorbs as high as 23% of the f.o.b.t. realisations on high and medium grade ores of Madhya Pradesh—Maharashtra. In the context of declining sales prices, the incidence of the freight rate with direct repercussion on cost and profitability should be viewed with concern if the long-run development of the industry in the State is taken into consideration.

4. BAUXITE

Bauxite reserves in Madhya Pradesh are estimated to be of the order of about 45 MT. The important reserves are located in the districts of Jabalpur, Shahdol, Bilaspur, Balaghat and Satna. Present production comes from Jabalpur and Shahdol. During 1970 there were 11 mines operating in Madhya Pradesh, of which 10 were in Jabalpur and one in Shahdol. But, the production of the single mine in Shahdol is more than that of all the 10 mines in Jabalpur put together. Total production of bauxite in these two districts in 1970 were 119,822 tonnes and 116,228 tonnes respectively. Total production of bauxite in Madhya Pradesh consitutes about 15% of all India production. In production of bauxite, Madhya Pradesh ranked third in India in 1970. The first two States are Bihar (35%) and Gujarat (17%). Bauxite production in Madhya Pradesh has been increasing steadily during the last ten years. Total production increased from 47,512 tonnes in 1960 to 236,050 tonnes in 1970. This is an increase of as high as 400%. There are good future prospects for the industry in this State.

CHAPTER VI—MAHARASHTRA

1. INTRODUCTION

1.1.1 In the mineral economy of India, position of Maharashtra is not very significant. It stands eleventh among the mineral producing States of India. Its contribution to total mineral production of the country is only 2% (Table 1.1.1). **Minor Role**

Table 1.1.1 : Share of Maharashtra in the Mineral Production of India, Major Minerals and Minerals Under Study, 1966-70

(Million Rupees)

Year	Major Minerals			Minerals Under Study		
	India	Maha-rashtra	% Share	India	Maha-rashtra	% Share
1966	2,917.1	65.2	2.2	419.1	25.0	7.0
1967	3,317.7	77.7	2.3	449.0	33.6	7.5
1968	3,810.4	85.4	2.2	499.8	27.5	5.5
1969	4,240.3	83.5	2.0	514.2	21.7	4.2
1970	4,296.3	85.2	2.0	558.0	24.0	4.3

Source: IBM—Mineral Statistics of India, January 1971.

Maharashtra's contribution to the mineral extraction of the country declined considerably during the last ten years. Its share in the total value of mineral production in India declined from 3.5% in 1960 to 2.0% in 1970. This decline in the relative share is due, first, to decreasing manganese ore production (during 1965-70) and its price in Maharashtra as well as India, and second, to accelerated production of iron ore for steel production and export in the other States. The impact of the decline in the value of manganese ore production is more clearly felt in the data for the minerals under study. It would be noticed from the table that share of Maharashtra declined very sharply—from 7.5% to 4.3% during 1967-69—in the all India production of minerals under study. This is due to the decline of manganese ore production in the State from about Rs. 35 million to Rs. 13 million during the same period.

1.1.2 Manganese ore, however, still continues to be the most important non-coal mineral of Maharashtra. This constitutes about 60% of the total value of non-coal mineral production of the State, Other two major non-coal minerals are iron ore (about 22%) and kyanite (17%). Kyanite mining is a very recent development in the mining history of Maharashtra, the first commercial output **Manganese Ore the Most Important Mineral**

being reported only in 1969. Besides manganese ore, iron ore and kyanite, other minerals mined in Maharashtra are bauxite and chromite. Relative shares of different minerals in the total mineral production of Maharashtra are shown in Table 1.1.2.

Table 1.1.2 : Production of Mineral Under Study in Maharashtra and Shares of Individual Minerals, 1970

Mineral	Production	
	Million Rs.	% Share
Total	24.0	100.0
Manganese Ore	13.8	60.0
Iron ore	5.0	21.7
Kyanite	3.9	17.0
Bauxite	1.0	4.2
Chromite	0.3	1.3

1.3 A separate analysis of the manganese ore industry in Maharashtra has not been attempted but is included in the analysis of the Maharashtra—Madhya Pradesh manganese ore belt.

2. IRON ORE, KYANITE BAUXITE, CHROMITE

Iron Ore

2.1 Iron ore reserves in Maharashtra are estimated to be of the order of 72 MT. Number of operating mines are 6 compared to the all India number of 299. Total production of iron ore of all grades during 1970 was 0.45 MT. This constituted about 1.5% of the all India production during the same year. Iron ore production in Maharashtra reached an all-time peak in 1970. Production in 1960 was 0.32 MT ; in 1965 it was 0.39 MT and in 1969 it slumped to 0.27 MT. Number of working mines increased from 3 in 1969 to 6 in 1970. All the mines are located in Ratnagiri district and the entire production of the State comes from this district.

Kyanite

2.2 As mentioned in the 'Introduction', kyanite mining is a very recent development in the mining history of Maharashtra, the first commercial output being reported only in 1969. Kyanite deposits are located in the Bhandara district. Total production in 1969 was 10,481 tonnes and in 1970 was 16,350 tonnes. In 1969 there was only one kyanite mine operating in Maharashtra. In 1970, the number increased to two compared to 14 mines operating all over India. In kyanite production, Maharashtra ranks only next to Bihar, which accounts for about 86% of all India production. Maharashtra's share in all India production is about 14%.

2.3 Bauxite deposits in Maharashtra are located in the districts of Kolaba, Kolhapur and Ratnagiri. Total reserves are estimated to be of the order of 48.7 MT. Total number of working mines are 5 of which 3 are in Kolaba, and one each in Kolhapur and Ratnagiri. But, the mine in Kolhapur accounts for about 90% of Maharashtra's production. During 1970, out of a total production of 121, 354 tonnes in Maharashtra, production of the Kolhapur mine was about 109,876 tonnes. Maharashtra's share in all India production during 1970 was about 9%. **Bauxite**

2.4 Chromite production in Maharashtra is negligible compared to the all India production. During 1970, there was only one mine operating in Bhandara district and production of this mine was 2,543 tonnes. This constituted about 1% of India's production during the same year. Maharashtra is known to have a probable reserve of 0.6 MT of chromite. Important pockets are reported in Pauni (0.48 MT) in Bhandara district and Sawantwad (0.07 MT) in Ratnagiri district. **Chromite**

CHAPTER VII—MYSORE

1. INTRODUCTION

1.1.1 Mysore ranks eighth among the mineral producing States in India. The total value of the major minerals produced in Mysore during 1970 amounted to Rs. 117 million and the State's contribution to the total value of major minerals produced in the country was a meagre 2.7%. The value of minerals produced in the State has been increasing, except during 1969 when there was a fall due to decrease in production of iron ore, manganese and gold (Table 1.1.1). Mysore's contribution to the total value of production of the minerals under study is only 5.8% even though the State has some of the best deposits of iron ore. A sudden spurt in production of iron ore and manganese ore accounts for the sharp increase in 1968. Production fell in 1969 and has steadied itself in 1970.

Table 1.1.1 : Share of Mysore in the Mineral Production of India, Major Minerals and Minerals Under Study

(Million Rupees)

Year	Major Minerals			Minerals Under Study		
	India	Mysore	% Share	India	Mysore	% Share
1966	2,917.1	83.3	2.8	419.1	26.5	6.3
1967	3,317.7	88.2	2.6	449.0	29.0	6.5
1968	3,810.4	116.9	3.1	499.8	35.7	7.1
1969	4,240.3	99.1	2.3	514.2	29.1	5.6
1970	4,296.3	116.9	2.7	558.0	32.6	5.8

Source : IBM—Mineral Statistics of India, January 1971.

Table 1.1.2 : Production of Minerals Under Study in Mysore and Share of Individual Minerals, 1970

Minerals	Production	
	Million Rs.	% Share
Total	32.6	100.0
Iron ore	17.1	52.4
Manganese	13.5	41.7
Bauxite	1.7	5.2
Chromite	0.3	0.7

Source : IBM—Mineral Statistics of India, January 1971.

1.1.2 It would be noticed from Table 1.1.1 that the minerals under study contributed only 28.1% of the total value of minerals produced in Mysore in 1970. Mysore is the largest producer of gold, with a total value of production accounting for more than 50% by value of the State's mineral production. Among the minerals under study iron ore (52.4%) and manganese ore (40.1%) are the two most important minerals.

2. IRON ORE

2.1 Introduction

2.1.1 Although Mysore is richly endowed with some of the best deposits of iron ore, large scale mining was not attempted till recently. The first attempt was made at Kemmangundi in 1923 to feed the requirements of a small sized charcoal pig iron plant at Bhadravati. The rapid growth of the steel industry in post-war years has stimulated mining and there has been a steady growth increasing the production from 0.3 MT in 1956 to over 3.4 MT in 1968.

2.2 Reserves

2.2.1 Iron ore reserves in Mysore are estimated at 1,484 MT and its contribution to all India reserves is 15.3%. Occurrences of ore in Mysore has a distinct feature as compared to other States. Both hematite and magnatite ores are fairly well represented in Mysore unlike in Bihar, Orissa and Madhya Pradesh where hematite deposits predominate. Workable hematite deposits are found in Bellary, Chikamagalur, Chitaldurg, Shimoga, Tumkur and South Canara districts. The Bellary-Hospet ranges have an estimated reserve of 498 MT.

Vast areas of magnetite-quartzite occurs in Kudremukh, where the reserves are estimated at over 1,000 MT, and the Aroli, Gangrikal and Gangamula ranges near the western border of Chikamagalur district. This horizon of magnetite-quarzite extends over an area 30 kms in length and 10 kms in width. The iron (Fe) content of hematite ore usually varies from 60-67%. The magnetite ores contain 30-35% Fe and about 50% silica.

Table 2.2.1 : Reserves

S. No	Deposits	Million Tonnes
1	Bellary—Hospet	498
2	Hematite area of Chittaldurg, Chikamagalur and Shimoga	771
3	Magnetite ores of Chikamagalur, Tumkur etc.	215
4	Kudremukh deposits	over 1,000

Source : A status report on iron ore development programme.

2.3 Structure of Iron Ore Industry in Mysore

2.3.1 Mining of iron ore in the Bellary-Hospet region of Mysore is at present limited to a few big operators (about 10 operators producing above 50,000 tonnes a year) and a large number of small scale operators whose production vary from a few tonnes to 50,000 tonnes and account for about 2 MT of the State's total iron ore production. There were 113 iron ore mines in Mysore by the end of 1970. All types of ownership viz. proprietorship, partnership, private and public limited companies are prevalent in Mysore. The number of mines in the private sector is much more than that in the public sector. During 1970, there were 6 mines in the public sector. Two of the important mines in Mysore are the B.R.H. mine of Dalmia and Kemmangundi mine of the Mysore Iron and Steel Works. Even these two mines are not among the major mechanised iron ore mines in the country.

Type of Working

2.3.2 Large scale mining activity at present is restricted to the Hospet and Sandur ranges. Mining in this region is very primitive. Excepting a couple of operators using some mechanical equipment for mining, all the other operators are engaged in what can be termed as surface scratching. Unfortunately, these surface scratchers hold far too many small leases and it is estimated that they contribute 60% of the region's production. Quite a few of these small operators have mined the float ore and have abandoned working once the reef was exposed.

Degree of Mechanisation

2.3.3 Mining of float ore does not require any mechanisation. It is more of picking and choosing the lumpy ore There are only two mechanised mines and one semi-mechanised mine in the State. Two of the operators are at present working on the reef ore. Mechanical equipment like rippers, dozers etc. is being used to expose the reef. The captive mine of the Mysore Iron and Steel Limited at Chickamagalur is a mechanised mine and has an average yearly production of 140 thousand tonnes. The other mechanised mine is that of the Dalmia group, where the production is about 0.5 MT/year. Degree of mechanisation is high in this mine because of the 1 : 8 ratio of ore to overburden.

2.3.4 Iron ore mines in Mysore are opencast. Extraction is done on hill slopes. In non-mechanised mine which are generally small and have float ore the entire mining is done manually. Mining is mostly on a single shift basis. The B.R.H. mine of Dalmia's works on a staggered shift to facilitate maintenance of equipment.

Employment

2.3.5 The average daily employment in the small lease areas is below 100. The medium sized mines having an average production of about 0.1 MT tonnes employ about 250-300 labourers per mine. The B.R.H. mine is only unit employing about 800 piece-rated labourers, 300 supervisory and 12 technically qualified personnel.

2.3.6 About half a dozen accidents with fatal injuries have been reported during the last five years. Under-cutting of benches and non-pursual of safety rules have been the main causes for these accidents. Minor injuries while handling mechanical equipment have also been rep· rted. Accidents

2.4 Production Trend and Grade Structure

2.4.1 Mysore with a total of 113 mines in 1970 accounts for about 38% of the total operating mines in India. As mentioned earlier most of the 113 mines are small mines with mining activity confined to the float ore. The number of mines has increased to 113 in 1970 as against 65 in 1968 even though the production has decreased from 3.4 MT in 1968 to 2.9 MT in 1970.

2.4.2 Mysore contributes only 9% of the country's production. There has been a fall in production of iron ore in 1969 and 1970 after a steady increase from 1.9 MT in 1960 to 3.4 MT in 1968. The fall in production is because the float ore has been almost exhausted and the mining of reef ore calls for a lot of know-how and investment. The small operators are not and will not be in a position to mine the reef, as the areas held by them are very small and larger areas have to be exposed before proper working of the reef can be undertaken.

2.4.3 Iron ore deposits found in Bellary district have a Fe content varying from 63-69%. Mining at present is being limited to the 65% and above ore. Rich deposits of lumpy ore are found in Hospet (belt running towards Bellary), the Kumaraswamy range and other ranges in Sandur Taluk and Kemmangundi range in Bababudan hills. It is reported that reef ore in Bellary—Hospet region averages 68-69% Fe with more lumpy ore than fines. Grade

Table 2.4.1 : Number of Iron ore Mines in India and Mysore

Year	India	Mysore
1966	299	86
1967	273	71
1968	257	65
1969	312	116
1970	299	113

Source : 1. DGMS—Statistics of mines in India, Vol. II, Non-coal, 1966, 1967 and 1968.
2. IBM—Mineral Statistics of India, January 1971.

Processing of Iron Ore

2.4.5 Beneficiation or agglomeration of the ore has not been contemplated because of the high grade ore that is being produced. Since the ore averages above 63% Fe, lower grade ore, if mined, is mixed with the high grade ore and utilised. However with the mining of the reef ore, the percentage of fines will increase due to increased mechanisation and utilisation of the fines will have to be given consideration.

Table 2.4.2 : Production of Iron Ore during 1961-70

(Million tonnes)

	All India	Mysore	
Year	Qty.	Qty.	% Share
1961	17.8	1.7	9.5
1962	19.1	2.3	12.2
1963	21.1	2.6	12.1
1964	21.9	2.6	11.6
1965	23.9	3.0	12.5
1966	26.7	3.4	12.7
1967	25.9	3.1	12.1
1968	28.0	3.4	12.3
1969	29.2	2.8	9.6
1970	30.8	2.9	9.4

Source : IBM—Mineral Statistics of India, January 1971.

2.5 Cost and Price Structure

2.5.1 The mining cost of iron ore in Bellary Hospet region is lower compared to the cost in other regions because of mining being restricted to float ore in most of the mines. Wages form a significant part of total mining cost. The other important cost components such as explosives, fuel etc. do not play a part in the mining costs at the non-mechanised mines. Detailed analysis of the cost and the trend has not been made since no data was provided during the survey.

2.6 Marketing and Transport

2.6.1 Mysore exports more than 80% of her iron ore production. The exports are canalised through the MMTC. Lumpy ore of 65% and above Fe content is exported to Japan and the shipments are made mostly from Madras Port. Mysore Iron and Steel Works is the largest consumer of iron ore in the State. The captive mine (Kemmangundi) meet almost the entire requirement of the steel plant. The grade used in the plant is 58-60% Fe.

2.6.2 Mineowners in the Bellary-Hospet region get a low price for the high grade ore they produce because of the high cost of transporting the ore to Madras port, which is located at a distance of 560 kms. This long lead, dictating a high freight rate, is responsible for the low price that is being paid to the mine-owners. The transportation lead to the port from different mining sectors in the country varies from as low as 65 kms in Goa to as high as 560 kms in the Bellary-Hospet region. Cost of transporting the ore to the port is not a major problem for Goa as the mining areas are close to the port and are served by a set of a navigable rivers. However, in the case of Mysore, the transport of ore is a major problem particularly for mineowners in the Bellary-Hospet region. For exporters of the ore from the above area Marmagao is the natural choice as it is nearer by about 200 kms than Madras. But at present the major quantity is shipped through Madras and is likely to be so in future also because of the broad guage link between the two places. The existing link can easily sustain a shipment of 5 MT a year. The development of facilities at Karwar port which is almost at half the distance would provide for the offer of the ore at competitive rates. Poor state of roads from the mines to the rail head is another important factor affecting the cost of transportation. The mined ore is moved by truck from mines to rail head over distances varying from 3 to 30 kms. As mentioned in the review of iron ore mining in Part II, Chapter 1 it is imperative that these roads be widened and asphalted for smoother flow.

2.7 Future Prospects

2.7.1 The iron ore industry in Mysore has got a very bright future with the public sector playing a dominant role. The National Mineral Development Corporation is developing a mine at Donimalai which is targeted to have a production of 3.5 MT of lumpy ore and saleable fines. In comparison to the existing production of 3 MT in the whole of Mysore State one can well imagine the significance of the project to the iron ore industry not only in Mysore but in the country as a whole. Mention must also be made here that for the first time in the iron ore industry of the country attempts are being made for the exploitation of the magnetite deposits. The NMDC has in collaboration with two foreign companies submitted techno economic feasibility studies for the development of the huge magnetite deposits in Kudremukh. Hitherto the magnetite deposits in different parts of the country have remained unutilised. The successful development of the Kudremukh deposit which is to export about 7.5 MT of ore in the form of slurry/pellets by 1975 will open a new avenue for full utilisation of the large magnetite deposits in other regions.

2.7.2 Mining of iron ore in the existing mines has reached a stage where mechanisation would be necessary for further development. As already mentioned the float ore is getting exhausted and the time has come to open up the reefs. Opening of the reefs call for increased mechanisation of the mining operations. With mechanisation the Bellary-Hospet mines would become capital intensive. At present there is no financial institution to assist the development of mines. It

is encouraging to note that the MMTC has already taken the initiative to interest State Financial Corporations and commercial banks to extend credit facilities to the mineowners.

3. MANGANESE

3.1 Geology and Reserves

3.1.1 Manganese ore deposits in Mysore are predominantly medium and low grade. Deposits are low in phosphorus and silica content. Londha in North Kanara district, Kammadheruvu and Ramadurg range in Bellary district, Sadarhalli in Chitaldurg and Chiknaya-Kanhalli in Tumkur district are locations of some of the important deposits. The estimated reserves of manganese ore in the State are 12.60 MT of 40-50% manganese content.

3.2 Structure of Manganese Mines

3.2.1 Manganese ore mining in Mysore is dominated by the private sector. The Mysore Minerals, a State Government undertaking is working mines in Shimoga and North Kanara districts. These mines are in different stages of development.

3.2.2 The mines in the Londha area of North Kanara district are relatively small in size and large in number (48 of 76 operating mines in 1970 were from this region). The production varies from a few tonnes to ten thousand tonnes. All the mines are opencast. Only half a dozen mines are semi-mechanised and the rest are non-mechanised. Bellary district is the largest producing sector and has one of biggest manganese ore mines in the country. The Sandur mine owned by the Sandur Manganese and Iron Ores Ltd. is a semi-mechanised mine and produces about 65% of the total production in the State.

3.3 Production Trend & Grade Structure

Increase in Number of Mines

3.3.1 The number of operating mines in Mysore increased by 40% in 1969 in comparison to the number of mines in 1968. The increase in number of mines has been in North Kanara district where a large number of small mines have been opened with the increase in demand for the ferro manganese ore.

Steady Increase in Production

3.3.2 Mysore is the only State where there has been no decline in production. Production has been steadily increasing though the production in 1969 was slightly less than the production in 1968. Production increased quite significantly in 1970 and is the maximum attained so far. The abject dependence on outside markets has been partly responsible for the instability in the manganese ore industry and the fluctuations in the all India production. However, as mentioned earlier, there has been stability in Mysore due to the Sandur Manganese & Iron Ores Ltd. The Sandurmine is the only manganese mine which has been operating steadily for the last sixty years and has not been affected by the vagaries and ups and downs in manganese export trade. The annual production from this

mine has been steadily increasing and the trend has been maintained. Thorough systematic working and planned development has contributed significantly to the increased production in Sandur.

Table 3.3.1 : Number of Manganese Mines Operating in Mysore

Year	All India	Mysore
1966	295	56
1967	303	58
1968	277	52
1969	426	77
1970	328	76

Source : 1. DGMS—Statistics of Mines in India Vol. II, Non-coal, 1966, 1967 & 1968.
2. IBM—Mineral Statistics of India, January 1971.

Table 3.3.2 : Production of Manganese Ore, All India and Share of Mysore
(Million tonnes)

Year	All India	Mysore	
	Qty.	Qty.	% Share
1961	1.41	0.27	19.1
1962	1.64	0.28	17.1
1963	1.32	0.24	18.2
1964	1.41	0.24	17.0
1965	1.65	0.29	17.6
1966	1.71	0.28	16.4
1967	1.62	0.26	16.0
1968	1.61	0.33	20.5
1969	1.49	0.32	21.5
1970	1.65	0.36	2.18

Source : IBM—Mineral Statistics of India, January 1971.

3.3.3 Manganese ore produced in Mysore is mostly medium and low grade. The ores of North Kanara di. trict and Sandur have high iron content and comparatively low manganese iron ratio. Even in the best grade ores the ratio is less than 6:1. The Sandur ores are characterised by low phosphorus, silica and alumina contents and are more suited for the European markets than other Indian manganese ores. **Grade**

Medium (38-42%) and low (below 38%) grade ore contribute about 90% to the total production of manganese in Mysore. Over the last five years this share of the medium and low grade ore has been quite steady. 44-48% and 42-44% Mn ore contribute only a meagre 8 to 10% of the total State production. Over the period of five years there has been no production of 48% and above ore.

3.4 Cost and Price Structure

3.4.1 Cost of mining of manganese ore varies rather widely, depending upon the richness of deposit, nature of working, thickness of over burden and the ratio of ore to waste. Excepting the Sandur mine, all the other mines are small with activity limited to a production of a few thousand tonnes. Labour is the predominant component in the mining cost, as most of these mines are non-mechanised. Detailed analysis has not been possible due to lack of data.

As mentioned in 3.3.2. the low phosphorus and alumina ore of Sandur have a good overseas market. The European and the Japanese prices have been increased in the past year and the shipments are likely to increase. The Japanese price for the Sandur A' grade ore (38/40% Mn) has recently increased from $ 15.50 to $ 17.00 and from $ 12.25 to $ 13.70 for Sandur 'C' and the European price for Sandur 'A' has been raised to $ 13.40. It is also reported that MMTC has recently negotiated new rupee prices which will improve sales realisation significantly.

3.5 Marketing & Transportation

3.5.1 Manganese ore industry in Mysore is export oriented. The Sandur Manganese & Iron Ores Ltd. is the largest exporter in the State. The quantity of manganese ore shipped by Sandur has increased significantly, from 176 thousand tonnes in 1968 and 207 thousand tonnes in 1969 to 286 thousand tonnes in 1970. The trend is likely to continue and it has been reported that the total shipment during 1971 and part of 1972 would be to the tune of 400 thousand tonnes. The 36/38% Mn grade and silicious ore are also likely to be exported. Japan and European countries are th ain buyers of the low grade, low phosphorus and low alumina manganese ..e. Manganese ore from Londha in North Kanara district is also exported. The ferro-manganese unit at Dandeli provides a stable market for a sizable portion of the production in North Kanara district.

Transport

3.5.2 Cost of transporting the ore from the mines to the railway station, high freight and non-availability of wagons are the three problems faced by the mine-owners in Mysore. In the Sandur sector the transportation distances from the mines to the loading stations vary from 5 to 13 kms, involving an average transportation cost of Rs. 5.60/tonne. In North Kanara sector, the average transportation cost is about Rs. 17/- per tonne. The unit cost of road transport can be reduced substantially if there is an improvement in the existing condition of the roads. There is a urgent need to improve the kutcha road between Dandeli and Joida, a length of 24 kms, for easier ore movement.

3.5.4 Transport of mined ore from Sandur is by means of two gravity ropeways 4 kms and 2.5 kms in length, connecting the mines located at the edge of a plateau to the rail heads at Samehalli and Sundarambencha on the Hospet-Samehalli metre gauge line. The two ropeways have a transport capacity of 400 tonnes/shift. In addition the company has a two feet gauge track over a distance of nearly 30 kms, for internal transport by diesel locomotives.

3.6 Future Prospects

There has been an increase in the demand for medium and low grade manganese ore in the domestic as well as foreign market. The trend is likely to continue. The impact of this increased demand has already been felt and the production has registered an increase in Mysore State.

However, it must be stated here that any increase in the different components of cost, particularly wages and railway freight, would adversely affect the industry. As mentioned earlier manganese ore mined in Mysore is predominantly medium and low grade with low unit value realisation. Any increase in prices will reduce the profitability and would force the operators to scale down their operations.

4. CHROMITE, COPPER, KYANITE AND BAUXITE

4.1 Mysore has an estimated reserve of 1.7 MT and accounts for 21.2% of the total chromite reserves in the country. Birapur area of Hassan district is the major chrome deposit in Mysore where almost the entire resource is found. With a chrome to iron ratio of 2 : 1, the ores in Mysore fall below the metallurgical grade. The average chrome content varies from 46 to 48%.

Chromite contributed only 0.9% of the total value of production in 1970 for the minerals under study. Apart from gold, this is the only other mineral which is mined by underground mining methods. At Baryapur in Hassan district, mining operations are carried out at a depth of 100 metres. This is the only underground chromite mine in the country. **Chromite**

Chromite production of Mysore contributed 1.7% to the total quantity of chromite produced in the country during 1970. Production has picked up with the increase in indigenous demand after mining operations had closed down in 1966 and 1967.

4.2 Copper deposits in Mysore are estimated at 4 MT of 2% copper. Drilling exploration during the last few years has indicated deposits of small extent at Ingladhal near Chitradurga and at Kalyadi in Hassan district. A Company styled Chitradurga Copper Company is operating the mine at Ingladhal to produce copper concentrates of 20%. The mine is in the development stage. Two levels has been developed and in the next two years it is hoped to develop **Copper**

the ore body down to the 6th level. The mine is expected to produce about 1,400 tonnes of copper per year when fully developed.

Kyanite

4.3 Chikamagalur district of Mysore reports a kyanite production of about 150 tonnes. The reserves are of no significance and the production forms an insignificant part of the country's production.

Bauxite

4.4 Total reserves of bauxite in Mysore are estimated at 5.7 MT. The average grade of the ore is 45-50% alumina.

There has been a gradual increase in the production of bauxite. As against a total production of 17 thousand tonnes in 1968, production of 85 thousand tonnes was reported in 1970, an increase of 400%. There are only two bauxite mines in Mysore and both of them are in Belgaum district.

CHAPTER VIII—ORISSA

1 INTRODUCTION

1.1.1 Orissa, with its rich natural resources, plays a significant role in the mineral economy of the country. By contributing Rs. 216.5 million in 1970 to the country's total major mineral production, she ranks fifth following Bihar, West Bengal, Madhya Pradesh, and Gujarat. But with regard to production of manganese, chromite, dolomite and limestone she is second to none.

Contribution to National Mineral Production Constant

1.1.2 Over the past five years, share of Orissa in the country's total value of minerals produced has almost remained constant (5.0%) although in terms of absolute value there has been an increase in her mineral production by 47% i.e. from Rs. 147.6 million in 1966 to Rs. 216.5 million in 1970 (Table 1.1.1). Taking the overall growth rate of the country we find a similar change. But an analysis of the trend of production of minerals under study shows that the growth rate (33%) in India during the five year period has been more than that in Orissa (27%). Orissa's share has declined from 18.7% to 17.8%.

Importauce of Minerals Under Study

1.1.3 Among the minerals of interest to the study, Orissa produces iron ore, manganese ore, chromite and kyanite. The relative importance of these minerals in the State's economy varies widely. Out of the total value of minerals produced in this State, iron ore contributes more than 64% (Table 1.1.2). Although Orissa stands first in India in terms of quantity of manganese ore produced, in terms of value manganese ore constitutes only 22% of her total production of minerals under study. The main reason is that Orissa's manganese ore being low grade, its unit value is very low. Orissa produces more than 90% of high grade chromite in India. But owing to low absolute volume of production its contribution to the State's total production is little less than 14%. Kyanite mining in this State has started very recently and its share in the value of minerals produced is insignificant.

Table 1.1.1 : Share of Orissa in the Mineral Production of India—All Minerals and Minerals Under Study.

(In million rupees)

Year	All Minerals			Minerals Under Study		
	India	Orissa	%	India	Orissa	%
1966	2,917.1	147.6	5.0	419.1	74.4	18.7
1967	3,317.9	156.4	4.7	449.0	84.1	18.7
1968	3,810.4	190.0	5.0	499.8	93.8	18.8
1969	4,240.3	207.0	4.9	514.2	96.2	18.7
1970	4,296.3	216.5	5.0	558.0	99.5	17.8

Source : IBM—Mineral Statistics of India, January 1971.

Table 1.1.2 : Production of Mineral Under Study in Orissa and Share of Individual Minerals 1970

(In million rupees)

Mineral	Value	%
Iron ore	64.0	64.3
Manganese	21.8	21.9
Chromite	13.7	13.8
Kyanite	0.08	—

Source : IBM—Mineral Statistics of India, January 1971.

1.1.4 In the sections that follow our analysis have been confined to iron ore and manganese ore. As regards chromite, Orissa's production almost coincides with India's production. Since this mineral is discussed in great detail in Part II, it has been excluded from the present analysis. Kyanite, being a very insignificant mineral in this State also does not find a place in the present analysis.

2. IRON ORE

2.1 Geology and Reserves

Largest Reserves

2.1.1 Orissa stands first among the Indian States for her iron ore reserves. With 3200 million tonnes of exploitable iron ores she accounts for nearly one-third of the country's total iron ore resources. Occurrences of hematite ore is more predominant than mangnetite ore. Both these two types of ore occure in Pre-cambrian rocks. While hematite ores occur in association with banded iron ore in the districts of Keonjhar, Sundergarh, Mayurbhanj and Cuttack districts, traces of mangnetite ore are found in basic rocks in the district of Mayurbhanj.

2.1.2 Areas where vast hematite deposits have been found are Bolani, Banspani, Thakurani, Kurband and Phuljhora in Keonjhar district, Malangtoli, Khandadhar and Koira in Sundergarh district and Tomka and Daitari in Cuttack district. The district of Keonjhar takes the lead in the iron ore reserves of the State. The largest deposit of the State is found at Malangtoli (739 MT). This deposit is yet to be exploited. However, steps are being taken to start mining operation in this area under the public sector. Other important pockets of iron ore are Banspani (593 MT), Bolani (489 MT) and Thakurani—Deojhar (353 MT).

2.1.3 Magnetite ore is of less importance in the State and occurs in the form of veins, lenses and pockets in basic rocks. Unlike hematite ore, it is not so wide-spread. The only district which is reported to have magnetite ore is Mayurbhanj. These ores are titaniferous and the usual titania and vanadia contents vary from 10 to 20% and 0.5 to 3% respectively. Mining in this type of ore has yet to start in the State.

2.2 Structure of Iron Ore Mines

2.2.1 Iron ore accounts for the largest number of mines in the State. There are at present 58 mines. But the degree of their concentration varies much. The district of Keonjhar, with 46 mines, takes a lion's share. Mayurbhanj which witnessed the initiation of mining activity in this State now has few mines. Because of the exhausation of reserves, mining activity in this district is closing down.

2.2.2 Prior to 1956, the entire mining activity had been confined to private sector only. Iron ore mining in the public sector started with the establishment of the Orissa Mining Corporation. Now the Corporation is operating 7 mines. Besides, two mines of Hindustan Steel Ltd. are located in the State. Among the major iron ore mines, mention may be made of Barsua (Hindustan Steel Ltd.) and Daitari (Orissa Mining Corporation) in the public sector and Bolani (Bolani Ores Ltd.) and Joda East (Tata Iron Steel Co.) in the private sector.

Public vs Private Sector

2.2.3 Extraction of ore from reefs is more common than mining the float ore. This has required many of the mines to use drills for blasting reefs. The degree of mechanisation in small mines is therefore more as compared to Mysore or Goa, where, the large number of mines dealing with float ore do not use any mechanical power. There are a few mines which are fully mechanised. These include Joda East, Bolani and Barsua. The crushing, screening and washing plant at Daitari has yet to start operation because of some legal troubles.

2.3 Production Trend and Grade Structure

There has been no significant increase in the number of mines operating in the State. As against 49 mines in 1966, the number has gone up to 58 in 1970. (Table 2.3.1) Same trend is noticed in both public sector and private sector mines. Public sector accounts for about 16% of the total number of iron ore mines in the State.

Table 2.3.1 : Number of Iron ore Mines Operating in Orissa—Total, Public Sector and Private Sector

Year	Total		Public Sector		Private Sector	
	No.	%	No.	%	No.	%
1966	49	100.0	8	16.3	41	83.7
1967	52	100.0	9	17.3	43	82.7
1968	48	100.0	7	14.6	41	85.4
1969	54	100.0	9	16.7	45	83.3
1970	58	100.0	9	15.5	49	84.5

Source : ORG Mineral Survey.

2.3.2 Orissa stands third in the country with regard to iron ore production, following Goa and M.P. An analysis of production data over the past ten years shows that as against 3.7 MT in 1960, iron ore production increased to 6.8 in 1966, an increase by 84% (Table 2.3.2) This was the highest production over the past ten years. Since then production has been fluctuating, with a net decline by 1970. As mentioned in Part II, Chapter I, lack of an adequate outlet to dispose of their produce is the main reason for scaling down production at many mines.

Declining trend in Production

Table 2.3.2 Production of Iron Ore—All India and Share of Orissa, 1961-70

(In million tonnes)

	All India	Orissa	
Year	Qty.	Qty.	%
1961	17.8	4.7	26.4
1962	19.1	5.4	28.6
1963	21.1	6.0	28.4
1964	21.9	5.7	26.1
1965	23.9	6.7	28.1
1966	26.7	6.8	25.6
1967	25.9	5 7	22.0
1968	28.0	6.1	22.0
1969	29.2	6.6	22.7
1970	30.9	6.2	20.4

Source : IBM—Mineral Statistics of India, January 1971.

2.3.3 Although there has been no significant change in the number of public sector mines, in terms of production public sector has been coming to prominence. In 1966, production from public sector mines was 0.8 MT. Presently, the mines of public sector contribute nearly 23% of the State's production although they constitute about 16% of the total number of iron ore mines (Table 2.3.3). Contribution from the private sector has declined over the past five years.

Prominence of Public Sector

Table 2.3.3 : Iron Ore Production in Orissa—Total, Public Sector and Private Sector

(In million tonnes)

	Total	Public Sector		Private Sector	
	Qty.	Qty.	%	Qty.	%
1966	6.8	0.8	11.8	6.0	88.2
1967	5.7	0.8	14.3	4.9	85.7
1968	6.1	C.9	14.8	5.2	85.2
1969	6.6	1.2	18.2	5.4	81.8
1970	6.2	1.4	22.6	4.8	77.4

Source : IBM—Mineral Statistics of India, January 1971.

2.3.4 So far as grade is concerned, Orissa ore is generally of high grade. Except for a couple of mines at Daitari and Barsua, most of the iron ore mines produce ore of above 62% Fe. A number of mines in the Banspani sector produce even ore of above 65% Fe. Grade

2.4 Processing of Iron Ore

2.4.1 Processing of iron ore in this State, at present, is not a major problem for two reasons. Firstly, the iron content of ore is most of the areas is high. Secondly, the ratio of fines to lump is the lowest among all the States. Presently, there is a beneficiation plant attached to the mine at Barsua since the Fe content in this area is low. The plant at Daitari which is yet to go into operation has also made provisions for washing its low grade ore. Fines which constitute about 20 to 30% of production are at present thrown away as waste except at a few mines where they are sent to the steel plants for sintering. There has been no proposal to set up a pellitisation plant in the near future. Not a Major Problem

2.5 Cost and Price Structure

2.5.1 The average mining cost of iron ore in Orissa shows an upward trend. As against Rs. 2.84 in 1966-67, cost of mining touched the level of Rs. 4.77 in 1970-71, an increase by 64% (Table 2.5.1). Between public sector and private sector mines, the former shows a higher cost. The difference is about a rupee.

Table 2.5.1 : Mining Cost of Selected Mines in Orissa

(Rs. per tonne)

Year	Public Sector	Private Sector	Total
1966-67	3.86	2.51	2.84
1967-68	4.38	3.29	3.22
1968-69	4.46	3.99	4.18
1969-70	5.47	4.25	4.50
1970-71	5.72	4.16	4.77

Source : ORG Mineral Survey.

2.6 Marketing and Transportation

2.6.1 Iron ore from Orissa is used both for internal consumption as well as for export. As regards the internal market, the entire production of a few mines goes to the steel mills. These mines include Barsua and Kolta (Hindustan Steel Ltd. Rourkela), Joda East and Khandbandh (Tata Iron & Steel Co., Jamshedpur) and Bolani (Hindustan Steel Ltd., Durgapur). Besides, certain quantities of iron ore from quite a few other mines are also consumed by these steel plants, except the Tata Iron and Steel Co. which gets its entire supply from its captive mines. Internal Requirement

Export

2.6.2 As regards export, the entire production of the mine at Daitari is shipped to Japan. Besides, quite a substantial amount of ore is also despatched from the Banspani sector for export.

Insufficient Outlet

2.6.3 The difficulties of marketing in this State are broadly the same as those for the country. However, there are a few specific problems which need mention here. During the visit to the Banspani sector, the main pocket of iron ore in the State, it was gathered from the mineowners that they have difficulty in marketing their produce since the intake by MMTC has decreased. There were cases where mines have been closed down since it became uneconomical for the mineowners to carry out production below a certain level.

2.6.4 The port at Paradip which is far off from the mines has not been connected by any rail link till now. Presently, ore from Banspani sector has to travel about 600 kms to reach Dhanmandal or Nergundi and from there it is transported to Paradip by road over a distance of about 100 kms. This enhances the transportation cost to a great extent. A rail link between Cuttack and Paradip is under construction. Feasibility studies to connect Banspani with Jakhpura in the main Kharagpur—Cuttack line are in progress. If this link materialises than the distance of Paradip from Banspani sector will be reduced by half. Further, this will also eliminate the cost of transporting ore by road from Dhanmandal/Nergundi since there will be direct rail link up to Paradip.

Extension of Railway lines from Banspani to Joruri

2.6.5 It was ascertained from our meeting with the officials of the Mineowners' Association of Banaspani-Barjamda sector that pending the construction of the rail link between Banspani and Jakhpura, extension of the present Banspani railway siding up to Joruri, a distance of 10 kms, will benefit a number of mineowners by reducing the distance of road haul by 6 kms and thereby reducing the transportation cost. It may be mentioned here that sometime back a feasibility study on the proposed Banspani-Bimlagarh-Talcher rail link had been prepared. Conducting another feasibility study in the same sector appears to have been directed by economic reasons. Considering the fact that the Banspani-Joruri rail link falls in both of the two proposed rail links, extension of the rail line from Banspani to Joruri appears to be a sound proposition.

Handling Difficulties at Port

2.6.6 The targeted ore handling capacity of Paradip port is 4 MT of iron ore per year. But the port has yet to achieve its full capacity. At present, it is able to handle ore up to 2.4 MT. Silting and transport difficulties are the two major handicaps in achieving the full capacity. For this reason sometimes ore is diverted to Vishakhapatnam port, which involves higher freight charges.

2.7 Future Prospects

2.7.1 With the largest iron ore reserves in the country, the State can forge ahead in iron ore mining and can play an important role in the country's ambitious future production plan. Work is already afoot to exploit the huge reserves in Malangtoli in public sector. The mine at Daitari is expected to

produce 2 MT in near future. In the private sector Bolani Ores Ltd. is contemplating mechanisation of one of their manual mines so as to reach a production level of 2 MT. These developments are signs of greater activity in the industry.

3: MANGANESE

3.1 Geology and Reserves

3.1.1 Manganese ore reserves of Orissa, although low in grade, are quite large. The measured and indicated reserves of the State have been estimated to be not less than 22 MT. Most of the deposits are shallow. The manganese content of ore is very low ; about 70% of the ore have a manganese content below 40%. These ores are generally low in phosphorous and high in iron.

3.1.2 There is uneven distribution of the reserves in the State. Among the few districts reporting manganese ore reserves, Keonjhar possesses the largest share, about 70%. Next to Keonjhar comes Sundergarh where about a quarter of the State's reserves have been discovered.

3.2 Structure of Manganese Mines

3.2.1 With regard to number of mines operating, manganese comes next to iron ore with 37 working mines. Here again more than 50% of mines are found in Keonjhar district. At present all the mines belong to the private sector.

Less Mechanisation

3.2.2 There is a wide variation in the size of mines both in terms of production as well as employment. None of the mines in this State is fully mechanised. Use of mechanical power is confined to drilling with the help of compressor for blasting. Among the major mines in Orissa, mention may be made of Mahalsukha (Aryan Mining and Trading Co.), Joda West (Tata Iron & Steel Co.), Orahuri and Patmunda (Orissa Manganese and Minerals Co.). All the mines in this State are opencast. The depth of pits varies from 6 metres to 70 metres. Grading is done visually by the skilled labourers who are called pickers. At the time of heavy rains water-logging in lower benches leads to suspension of extraction in the lower portion of the pit. Besides, scarcity of labour during the peak agricultural season is reported.

3.3 Production Trend and Grade Structure

3.3 1 The numer of mines operating in the State does not show any definite trend. During the five year period for which analysis has been made, highest number of working mines (54) is noticed in 1969. (Table 3.3.1). The fluctuation is mainly accounted for by the very small mines which generally operate on the basis of indents they get for selling their produce.

Table 3.3.1 : Number of Manganese Mines Operating in Orissa

Year	Number
1966	42
1967	46
1968	44
1969	54
1970	37

Source : 1. DGMS—Statistics of Mines in India, Vol. II, Non-Coal, 1966, 1967 and 1968.

2. IBM—Mineral Statistics of India, 1970, 1971.

First in India's Production

3.3.2 Orissa stands first in the country's manganese production. This has been noticed in the past ten years. No significant change is noticed in Orissa's manganese production. As against 0.4 MT; in 1960, manganese ore production in Orissa in 1970 was 0.5 MT; an increase by about 25% (Table 3.3.2). But since last six years production has almost remained constant. This is also more or less true for the country as a whole.

Table 3.3.2: Production of Manganese Ore, All India and Share of Orissa, 1961-70

(In million tonnes)

	All India	Orissa	
Year	Qty.	Qty.	%
1961	1.4	0.4	28.6
1962	1.6	0.4	25.0
1963	1.3	0.4	30.8
1964	1.4	0.4	28.6
1965	1.7	0.5	29.4
1966	1.7	0.5	29.4
1967	1.6	0.5	31.2
1968	1.6	0.5	31.2
1969	1.5	0.5	33.3
1970	1.7	0.5	29.4

Source : IBM—Mineral Statistics of India, January 1971.

3.3.3 Although Orissa's manganese ore production is the highest in the country, more than half of it is low grade ore and another quarter medium grade ore. Distribution of manganese ore production grade-wise during 1969 shows that 59% of the ore produced are of low grade (below 38%). The percentages for medium grade (38-44%) and high grade (45% and above) are 27% and 14% respectively. **Low Grade**

3.4 Processing of Manganese Ore

3.4.1 Beneficiation of manganese ore in Orissa deserves more attention than in any other major producing States owing to the poor quality of its vast reserves. The three ways in which beneficiation of manganese ore can be thought of are reduction of the iron content, reduction of phosphorus content and upgrading of low/medium grade ore by simple techniques, such as washing. **Three Ways of Beneficiation**

3.4.2 The Regional Research Laboratory located at Bhubaneswar has been doing useful research in this field. Some of the results of the laboratory show that because of the intimate association of iron oxides with manganese oxides, the conventional ore dressing methods are not expected to yield satisfactory results in reducing the iron content. As regards reducing phosphorus content, the same problem has been faced. Evolving alternative methods to meet these problems is under study. It is expected that by simple washing methods upgrading can be done to an extent of 5-10%. The Ore Dressing Division of the National Metallurgical Laboratory has also been engaged in investigating the possibility of adapting various ore dressing techniques to upgrade manganese ore in Orissa.

3.5 Cost and Price Structure

3.5.1 Mining cost, in the mines visited, varies widely. This is not only true for Orissa but also for India as a whole. It will be seen from Part II, under "Manganese Ore", that difference in mining cost is accounted for by geological reasons. An idea about the variation in mining cost can be obtained from Table 3.5.1 which gives data on mining cost in two selected mines of the State. **Variation in Mining Cost**

Table 3.5.1 : Mining Cost

(Rs./Tonne)

Year	No. 1	No. 2
1968	29.0	16.2
1969	36.1	18.9
1970	42.0	21.3

Source : ORG Mineral Survey.

Mining of Low Grade Ore Not Economical

3.5.2 Cost data for different grades are not calculated separately. The mine-owners take the average cost of the total production which include all grades. On the other hand, the sales price varies with grade. The price of ore with more than 50% Mn is about ten times the price of ore with 30-35% Mn. It is noticed from the cost and price analysis that mining of manganese ore in this State with less than 40% Mn may not be profitable since the average f.o.r. cost is either less than the price realisation or marginally above it. Mining of ore with less than 35% Mn is ruled out since f.o.r. cost is higher than the price realisation. During the survey, it was observed that mineowners who produce more of high grade ore are better off than those who mine less of such ore. Since in majority of the cases the ores produced are not of high grade, the mineowners have been facing great difficulties in carrying out mining activities profitably.

3.6 Marketing and Transportation

3.6.1 Consumption of manganese ore inside the State is confined to the only steel plant, the only pig iron plant and the two ferro-manganese units. The rest of the ores produced are either despatched outside the State for domestic consumption or exported. Ports handling most of the manganese ore from Orissa are Vishakhapatnam and Calcutta.

3.7 Future Prospects

3.7.1 As mentioned earlier, Orissa's manganese ore is of low grade and hence most of its production is, at present, not suitable for use in ferro-manganese plants. Since in future, the demand for both high grade and low grade manganese ore is expected to be high because of the establishment of new ferro-manganese plants and steel plants, Orissa should take the advantage of this opportunity to the fullest extent. Intensive efforts are called for to find out the possibilitles of beneficiating its low grade ore so as to make manganese mining more profitable than what it is today. This will also help the State to conserve its natural resources.

CHAPTER IX—RAJASTHAN

1. INTRODUCTION

1.1.1 Rajasthan ranks twelfth among the mineral producing States in India. The total value of major minerals produced in the State during 1970 amounted to Rs. 58 million and the State's contribution to the total value of major minerals produced in the country was 1.3%. The value of minerals produced in the State has increased every year since 1967, the compound rate being 14% per annum between 1967 and 1970 (Table 1.1.1). Rajasthan's contribution to the total value of production of the minerals under study is only 3.1% even though the State enjoys a monopoly with respect to lead-zinc production and ranks third among the States producing mica.

1.1.2 Rajasthan is the only State in the country producing emerald, garnet and lead, zinc, cadmium and silver ores and has been traditionally first in the production of gypsum, wolframite, asbestos, calcite, felspar, soap-stone and fluorite. Lead-zinc contributed 71.8%, mica 22.4% and copper 5.2% to the total value of production in the State of the minerals under study during 1970 (Table 1.1.2).

Table 1.1.1 : Share of Rajasthan in the Mineral Production of India, Major Minerals and Minerals under Study

(In million rupees)

Year	Major Minerals			Minerals Under Study		
	India	Rajasthan	% Share	India	Rajasthan	% Share
1966	2,917.1	34.0	1.2	419.1	12.2	2.9
1967	3,317.7	34.4	1.0	449.0	13.1	2.9
1968	3,810.4	43.0	1.1	499.8	16.0	3.2
1969	4,240.3	52.3	1.2	514.2	15.3	3.0
1970	4,296.3	58.1	1.3	558.0	17.4	3.1

Source : IBM—Mineral Statistics of India, January 1971.

Table 1.1.2 : Production of Minerals under Study in Rajasthan and Shares of Individual Minerals

Mineral	Production	
	Million Rs.	% Share
Total	17.4	100.0
Lead-zinc	12.5	71.8
Mica	3.9	22.4
Copper	0.9	5.2
Manganese	0.1	0.6

Source : IBM—Mineral Statistics of India, January 1971.

1.1.3 Mineral production in the State of Rajasthan has steadily increased during the last two decades. In 1950 there were only 50 mining leases and 37 prospecting licenses covering only twelve minerals, as against 702 mining leases on 134 prospecting licenses covering 35 minerals, in 1970.

Minerals under Study

1.1.4 Lead, zinc, copper and mica are the minerals studied during the present survey in Rajasthan. In the following sections analysis of copper and mica mining has been made. As regards lead-zinc, Rajasthan is the only State producing the metals in the country. A separate analysis has not been presented here since all aspects of the industry are covered in detail in Part II under "Lead-Zinc". A brief note on the status of the Saladipura pyrite deposit and the manganese and iron ore industry in Rajasthan has been provided.

2. MICA

2.1 Geology and Reserves

2.1.1 Clear ruby mica along with black spotted and stained mica is mined in different districts of Rajasthan. Mica bearing pegmatites are scattered over a wide area in central Rajasthan and are associated with rocks of different kinds. Mica is concentrated in pegmatite 20 cm to 50 cm away from the country rock contacts.

Mica occurs in a belt streching over a distance of 360 kms passing through Jaipur in the north-east to Udaipur in the south-west, broadening at the centre and extending further north-west to Ajmer and Kisangarh. The important deposits are distributed in Ajmer, Tonk, Bhilwara and Udaipur districts. Deposits of minor importance are reported in Alwar, Bharatpur, Jaipur, Sirohi and Sikar districts.

It is difficult to estimate accurately the reserves of mica. Attempts have been made but have not been very successful as the quality and grade, which are of great significance, cannot be assessed. The prospecting methods utilised are archaic. The conventional discovery rests on chance find during digging wells or ploughing. Pegmatites which are near the surface are being discovered and successfully worked.

2.2 Structure of Mica Mines in Rajasthan

2.2.1 Due to the erratic occurrences of mica lodes, mica mining is considered a gamble. The mica mines follow the wall contacts, particularly the one along the hanging wall. At places, the lodes are concentrated along the cores or occur pinching along the strike and dip.

Private Sector

2.2.2 Mica mining in Rajasthan is entirely a venture of the private sector. Most of the mines in Rajasthan are small and have production less than 30 tonnes a year. Proprietorship and partnership are the two common forms of ownership in the State. Excepting in the case of 4 mineowners in Rajasthan, the individual

capital investment of the mineowners is less than Rs. 750 thousand. Most of the mica leases are in Bhilwara district. There were about 125 holders in 1969. Four of the operators produce about 50% of the total production in the State. Other mines are worked by the smaller concerns.

2.2.3 More than 75% of the mines produce less than 30 tonnes a year. Systematic working is not being done in most of the mines; in the bigger units some mechanisation is used in the mining of mica. Hoists, haulages, jack hammers, drills and pumps are the equipment used. Most of the bigger operators have their own generating units as electricity is not available in the mining areas. **Low Degree of Mechanisation**

2.3 Production Trend

2.3.1 There has been a gradual decrease in the number of operating mines in Rajasthan. Rajasthan accounts for 35% of the total number of mica mines in the country and only 20-25% of production. As mentioned earlier more than 75% of the mica mines in Rajasthan have production less than 30 tonnes a year. Most of the mines that have been closed belong to this category. **Fall in Number of Mines**

2.3.2 There has been a gradual decrease in mica production in the country and this is observed in Rajasthan also. The decrease in production has been due to a variety of problems, with the primary problem being the poor prices fetched by the medium and low quality mica mined in the State. **Decrease in Production**

2.3.3 A large number of mines are not being fully exploited and quite a few are abandoned, as the lodes are lost and the pegmatites show no sign of pinching. Out of about 170 mines in Bhilwara district, only 40 mines are being worked regularly or intermitently. Most of the mines which have been worked to a depth of 200-250 ft have been forced to close down or curtail their operations because of high cost of production.

Mining is by underground methods. The depth varies from a few feet to about 400 ft. Water percolation is a problem particularly during the monsoon. This is overcome by continuous pumping. There is a general scaling down of operation by the bigger units. The smaller units shut down for about 3 to 4 months a year as most of the mines are in the interior and are unapproachable. **Type of Working**

Most of the mines in Rajasthan have employment of less than 50 personnel. This is because of the small scale of operation. Among the units surveyed there is only one mine employing more than 150 personnel and eight mines employing between 100 and 150. **Employment**

2.3.4 Mining of deep mines has become very uneconomical because of lack of electricity. Improper exploration of mica lodes has caused premature closure of mines. Opening and closure of mines is quite frequent in this region and is usually dependent on the demand for a particular quality and grade.

Grading of Mica

2.3.5 Mica is graded according to the size and quality. Black spotted, stained, warped and cracked, fair stained and clear ruby mica are obtained in Rajasthan. Quality of mica varies directly with the size and inversely with the existence of spots and stains.

Processing

2.3.6 Crude mica obtained from mines is dressed at the mine site using a sickle. Further dressing is done with a knife and then sent to Bihar for splitting, trimming etc. A small percentage of the mica scrap and waste, which account for more than 70% of the total mica produced, is utilised by 2 units to produce mica powder and one unit to produce mica bricks. The scrap mica that is available can easily sustain a larger production of bricks and mica powder. There are no fabricating units in Rajasthan.

Table 2.3.1 : Number of Mica Mines Operating in India and Rajasthan, 1966-70

Year	All India	Rajasthan
1966	665	201
1967	636	202
1968	634	208
1969	531	193
1970	504	176

Source : Indian Bureau of Mines.

Table 2.3.2 : Production of Crude Mica, All India and Rajasthan, 1961-70

(Thousand tonnes)

	All India	Rajasthan	
Year	Qty.	Qty.	% Share
1961	28.3	7.7	27.2
1962	28.5	7.4	26.0
1963	25.4	7.0	27.5
1964	22.8	5.5	24.1
1965	23.8	6.5	27.3
1966	22.9	5.8	25.3
1967	18.2	4.0	22.0
1968	18.3	3.9	21.3
1969	17.6	4.1	23.3
1970	16.3	3.4	20.8

Source : IBM—Mineral Statistics of India, January 1971.

2.4 Cost and Price Structure

2.4.1 Mica mining industry in India is a labour intensive industry. The cost structure of the surveyed units in Rajasthan shows that labour co-efficient is as high as 0.54 of the total cost. The other cost co-efficients are power and fuel 0.14, explosives 0.16, lubricant 0.04 and spares and stores 0.14.

High Labour Cost

2.4.2 The above cost coefficients are not constant coefficients. They vary quite widely, from one mine to the other. The cost data of the surveyed units in Rajasthan show that the average cost of mining a tonne of crude mica varies from Rs. 479.94 to Rs. 1,865.00. Wages, the most important component, varies from Rs. 255.26 to Rs. 1,248.61 per tonne, (Table 2.4.2). As explained in Part II under "Mica" the intermine variations in cost are due to the inherent nature of mica mining itself. Differences in unit mining cost of a cross section of big and small mines at different production levels during 1969 is shown in Table 2.4.1

Table 2.4.1: Unit Mining Costs of Selected Mines in Rajasthan and Their Production Levels in 1969

S. No.	Production (Tonnes)	Mining Cost Rs./Tonne
1	96.57	1,058.96
2	123.23	881.83
3	192.11	799.21
4	253.10	789.99
5	296.28	479.94

Source : ORG Survey of Mica Mines.

In addition to intermine fluctuations in total cost in a particular year, the total cost varies rather widely over the years. The variation over the years is not only due to increase in prices of the major mining equipment and wages but also due to alternations of rich deposits and barrens (Table 2.4.3). The minimum wages and prices of major mining accessories have increased substantially since 1960 (Table 7.3 of Part II, Chapter VIII). A detailed analysis has been provided in the mineral review of mica on the effect of the increased cost of inputs in all the three producing sectors in the country.

Table 2.4.2 : Total Cost of Production and the Cost Components for Selected Mines in Rajasthan, 1969

Rs./tonnes

S. No.	Total cost	Labour	Supervisory staff	Lubricant	Fuel (Diesel & Petrol)	Explosives	Stores, spare parts
1	1,058.96	287.07	188.79	33.78	259.54	208.55	81.23
2	479.94	163.83	91.43	20.66	77.76	70.76	55.50
3	1,865.00	1,248.61*	—	**	**	318.79	297.60
4	799.21	360.63	142.17	32.48	96.07	71.75	96.11
5	881.83	339.40	145.85	33.43	43.98	106.71	212.46
6	789.99	214.98	139.57	23.71	157.05	140.38	114.30

* Includes staff salary also.

** Included in stores.

Source : ORG Survey of Mica Mines.

Table 2.4.3 : Fluctuations in Total Cost and Major Cost Components of a Particular Mine in Rajasthan during 1965-66 to 1968-69

(Rupees/Tonne)

Component of Cost	1965-66	1966-67	1967-68	1968-69
Total	454.04	316.84	406.24	499.31
Labour Wages	115.49	111.36	117.53	163.83
Salary of Supervisory Staff	52.61	49.19	72.02	91.43
Petrol	17.71	1.92	7.59	6.98
Diesel oil	92.51	68.15	50.77	70.77
Lubricants	15.74	7.73	13.43	20.65
Explosives	105.50	40.31	78.97	70.78
Candles	17.23	15.92	14.97	18.43
Drill Rods	7.12	6.71	19.89	7.39
Spare Parts and Accessories	6.87	7.44	21.36	37.07

Source : ORG Survey of Mica Mines.

In the case of Rajasthan, the mineowners are forced to sell their dressed mica to buyers from Bihar. Lack of an export market forces the mineowners to market their mica at prices lower than the floor prices.

2.5 Marketing and Transportation

2.5.1 As mentioned the mica produced in Rajasthan is sold mostly to buyers from Bihar. The mica so purchased is taken to Giridih in Bihar for further processing and then exported along with Bihar mica. Because of the ports being situated at great distances and the rather low quality of scrap mined it is uneconomical to export scrap from this region. However, a small amount of ground mica is exported from Bombay port.

The mica mining industry in Rajasthan has a lot of problems in mining, marketing and transportation. The major problems facing the mica mining industry in Rajasthan are :

Problems

(i) lack of credit facilities
(ii) lack of electric power
(iii) bad roads
(iv) distress sales.

Lack of Credit Facilities

The fundamental problem of the mineowners in Rajasthan is the lack of credit facilities. Credit facilities are not available from the banks because of want of proper securities. Banks, including the State Bank, do not accept a

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mining lease as security because the lease can be cancelled for minor violations of attached conditions. Credit from banks is not available against hypothecation of stocks because of the difficulty of valuation of stocks of different kinds and qualities of mica.

Lack of Electric Power

Mica mining industry in Rajasthan suffers from lack of electric power. Mining in underground mines has become very uneconomical and quite a few operators have been forced to close down their mines. Negotiations have been in force for a long time between the Mewar Chamber of Commerce and the Rajasthan State Electricity Board (RSEB) for the solution of the problem. A committee was constituted which represents, among others, the Collector, the Executive Engineer RSEB, the Mining Engineer, Bhilwara and the Hony. Secretary, Mewar Chamber of Commerce. Details of the scheme involving both the RSEB and the mineowners are being worked out. It has been reported that the committee has decided that the RSEB will make the necessary investment for tranmission and distribution lines but the individual mineowners have to guarantee 18% return (outright cash payment) on the investment made by RSEB.

Bad Roads

The approach roads to the mines, particularly those in the interior, from the highway are in a very poor state. The scaling down of mining activity during the monsoon is primarily due to the areas being unapproachable. It is necessary that fair weather roads be constructed in the areas where there is a cluster of mines, so that mining is carried out continously and not in intervals. Lack of export market for Rajasthan mica is forcing most of the small producers to sell their produce at low prices to buyers from Bihar. Distress sales are very frequent in this region particularly for the smaller mineowners whose future production is dependent on the sale of what has been produced.

Need for Assistance in Locating Pegmatites

It has been reported that quite a few of the closed mines, which are not completely stoped, may be opened up if adequate facilities are available. However, it must be mentioned that proper methods should be utilised to explore the mica lodes. Underground, long-hose drilling may be carried out and this will be less expensive than putting unnecessary drives and cross cuts, as is being done now. As the geological setting is favourable for finding more mica pegmatites close to the surface and also in depth, assistance must be provided to the mica industry in this respect by organising a systematic search as most of the area is under lease.

3. COPPER

3.1 Introduction

3.1.1 Although the Khetri copper deposits have a long tradition of being worked since the Moghul times, their full potential as a major mineralised belt has come to light only through recent scientific exploration. The belt, according to present reports, extends from Nom Singhana to Raghunathpura. Several deposits of copper and iron pyrites have been located in this belt. While the

exploitation of the bigger deposits of copper as well as iron pyrites has been taken up, some of the smaller deposits still await effective utilisation Investigation for copper in other parts of the State has brought to light many more deposits of copper.

3.2 Reserves

3.2.1 Reserves of copper in Rajasthan are estimated at 111 MT of 1% Cu (Table 3.2.1). The deposits at Khetri are estimated at 106 MT with 70 MT at Madan Khudan and 31 MT at Kolihan. Some of the smaller but important deposits are at Bhagoni, Kho-Dariba and Akwali. There are other potential areas for copper deposits, that are now being investigated by the State Department of Mines and Geology and the GSI, at Rajgarh, Sendra and the Gadan belt of Bundi district.

Table 3.2.1 : Estimated Reserves of Copper in Rajasthan

Deposit	% Metal content	Estimated Reserves (Million tonnes)
Total	1.0	111.0
Khetri	1.0	70.0
Kolihan	1.4	36.0
Kho-Dariba	2.5	0.4
Bhagoni	1.0	1.5
Akwali	1.0	1.0
Satkin	1.5	1.0
Pur-Dariba	0.8	1.0

Source : 1. Department of Mines and Geology, Rajasthan.
2. Hindustan Copper Limited.

3.3 Structure of Copper Mines in Rajasthan

3.3.1 Copper mines in Rajasthan are at different stages of development and there is no fully developed copper mine in the State. Madan Khudan and Kolihan are the two mines which are being developed by the Hindustan Copper Limited to sustain a production of 8,600 tonnes per day (tpd) and 1,600 tpd respectively by 1978.

3.3.2 The entire Khetri complex including the development of the mines will cost Rs. 96 crores. According to the present schedule, production on a limited scale will commence from the upper levels towards the end of 1971 or beginning of 1972. The target of production of metal to the extent of 31,000 tonnes of copper is expected to be achieved by 1978.

Khetri

Hindustan Copper Ltd.

3.3.3 Th' National Mineral Development Corporation, a Central Government undertaking, was first assigned the responsibility for developing mines of these deposits and setting up a concentrator and a smelter to produce copper metal. In 1967, the Hindnstan Copper Ltd. (HCL) was set up by the Central Government with responsibility to develop all copper deposits of the country which may be of interest to the Government. HCL is developing the Madan Khudan and Kolihan deposits, and is investigating the feasibility of mining some of the smaller deposits in Rajasthan.

Madan Khudan Mine

3.3.4 When fully developed, Madan Khudan mine will produce nearly six times as much ore as the only significant working mine in India, the Mosaboni mine of the Indian Copper Corporation in Bihar. The mine is expected to reach a production rate of 8,600 tpd by 1978; the ore will have an average copper content of about 1% copper. The Madan Khudan deposits are estimated to contain 70 MT of 1% Cu. Dr. D.B. Sikka, who had conducted geological investigations in this area, has estimated a total reserve of 21 MT of 1.17% copper and has also reported that at present nearly 4/5th of the area under consideration has not been geologically investigated. If a rough projection is made, there is possibility of finding 70 MT of ore averaging 1% Cu (including the 21 MT). He has also observed that the strike length of a number of lenses are less than 100 metres having a fairly good depth extension. At present surface holes which have been drilled are spaced at 100 metres or larger intervals. It is likely that in a number of cases the lenses have been missed, It is probable that if surface drilling is done halfway between these drill holes, some of the areas which have been blocked out as lean grade mineralisation may contain potential lenses, which if found may add considerably to the ore reserve estimates.

Need for Intensive Exploration

Dr. Sikka's Observations

Dr. Sikka in his study has further observed that to sustain a production of 8,600 tpd or 2.5 MT/year of run-of-mine ore, the volume of rock blasted would be about 25.5×10^6 cu. ft. at 11 cu ft/tonne. Assuming a 30% wastage and a drive of 8 ft. by 10 ft. the length of tunnel to be driven would be approximately 85 miles/year. It is necessary that, before the targeted production can start, the lenses be delinated, access to ore body provided by sinking shafts for haulage and other services and levels established. All these operations, however cannot be telescoped and ore cannot start flowing till all the operations have been completed or advanced considerably.

Dr. Sikka has further observed that out of a total of 21 MT of ore reserves, 18.25 MT of 1.17% Cu. occurs above the 180 metre level and there is still scope of proving more ore reserves above this level once the lenses are opened up.

Present status of Madan Khudan

3.3.5 Ground level at the site is approximately 350 metres above the sea level datum being used in India. Over three fourths of the production will come from levels below the ground level. HCL is working on the development of the level

below ground, and at the same time driving into the hill to develop it to a production rate of 2,000 tonnes per day sooner than the below ground mine. The hill portion is estimated to contain about 6 MT of ore.

The below ground system will have a production shaft and a service shaft. The production shaft will be sunk to a depth of—80 metres (430 metres below ground level). The shaft has already reached a level of—41 metres. The service shaft is almost down to the 0 level, its ultimate depth. The two shafts will be linked by drives at 0 level, 180 metre level, 240 metre level and 300 metre level. Production will commence at the 180 metre level and the levels above it. Ore from the levels above the 180 metre level will be sent down to the 180 metre level from where it will go to the crusher in the production shaft below 0 level by means of an ore pass. The crushed ore will be transported to the surface by a system of high speed elevators in the production shaft. Drives at 120 and 50 metre levels to connect the two shafts will be made in course of time and mining done from them also at full production.

3.4 Processing of Ore

3.4.1 A process plant comprising of a concentrator for beneficiating the ore, a smelter to treat the concentrates and an electrolytic refinery for producing electrolytic grade copper is being installed. The scheme also envisages the utilisation of sulphur dioxide gases, produced during the process of smelting the concentrates, for the production of sulphuric acid, eventually to be utilised for the manufacture of fertilizers. The project is envisaged to produce 9,600 tpd and about 31,000 tonnes of electrolytic grade copper per annum. The sulphur values in the ore will be utilised to produce 600 tonnes of sulphuric acid and phosphoric acid per day. These acids would enable the company to produce about 214,400 tonnes of triple super phosphate fertilizer per annum. Apart from electrolytic grade copper, this project will also produce 8,000 ozs of gold and 64,000 ozs of silver per annum as by-products. The production of sulphuric acid and fertilizers are expected to be synchronised with the commissioning of the smelter (1973).

3.5 Future Prospect

3.5.1 With the start of production at Khetri the State will have the biggest copper complex in the country. Alongside Madan Khudan another mine is also being developed at Kolihan.

3.5.2 Kolihan deposits are estimated to have copper ore reserves of over 31 MT of 1.4% Cu. It is about 6—7 kms away from Khetri. Development of an underground mine is being synchronised with that of Madan Khudan mine. When fully developed the mine is expected to produce 1,600 TPD of 2.45% mill grade Cu. The ore produced is to be transported to the concentrator at Khetri. **Kolihan**

3.5.3 Madan Khudan and Kolihan mines when fully developed is expected to reduce the country's heavy dependence on imports of metallic copper to a certain extent. However, due to certain delays in the commissioning of the whole project, it has become necessary to develop supplementary sources for feeding the smelter. The important sources that are being developed include the hill portion of Madan Kudan mine, the Jodogoder mine where drives have been completed can sustain a production of 250 tpd. The production is expected to go up to 1,000 tpd. Some of the smaller deposits where geological investigations have been completed are to be mined if economical. The feasibility of working these small units is under the active consideration of Hindustan Copper Limited. Mention must be made here of the feasibility study conducted by the NMDC of the Kho Dariba copper deposit, in Alwar district. According to this study it is economically feasible to open up a mine capable of sustaining production of 250 tpd. The ore produced will be beneficiated in a concentrator and the concentrates will be sent to Khetri for smelting and refining. The capital cost of the project is estimated to be Rs. 18.1 million, which will produce 1,400 tonnes of copper metal per year.

4. Pyrites, Manganese & Iron Ore

4.1 The Geological Survey of India on the basis of drilling carried out so far has estimated that reserves of pyrite-pyrronite will be 85.54 MT of which 43.49 MT contain 25 to 30% sulphur and 42.05 MT contain 15% sulphur for the entire Saladipura area in Sikar district of Rajasthan.

Pyrites

The Pyrites. Phosphates and Chemicals Limited (PPCL) has been entrusted with the work of production oriented exploratory mining at Saladipura and to co-ordinate the activities of beneficiation etc. For this purpose a project report for exploration-cum-mining, beneficiation etc. has been sanctioned at a capital cost of Rs. 8.2 million. The operations which have already started will include underground mining, development, beneficiation studies, underground diamond core drilling, sampling and analysis. The need for consultants for planning this mine for a large scale production is being considered actively. The PPCL has plans to develop the mine to a production level of about 4,000 tpd. so as to provide a pyrite concentrate for a 1,000 tpd sulphuric acid plant.

Manganese

4.2 Reserves of manganese ore in the State is estimated at 2 MT. There is only one mine in Banswara and its contribution to the total manganese production in India and to the total mineral production in Rajasthan is very insignificant (0.01% and 0.1% respectively).

Iron Ore

4.3 Reserves of iron ore in the Udaipur district is estimated at 11 MT of 48% Fe and if mined will call for beneficiation. Two mines are operated in the Jaipur district and its contribution to the total iron ore production in India is insignificant (production value is Rs. 16 thousand as against Rs. 355 million in the country).